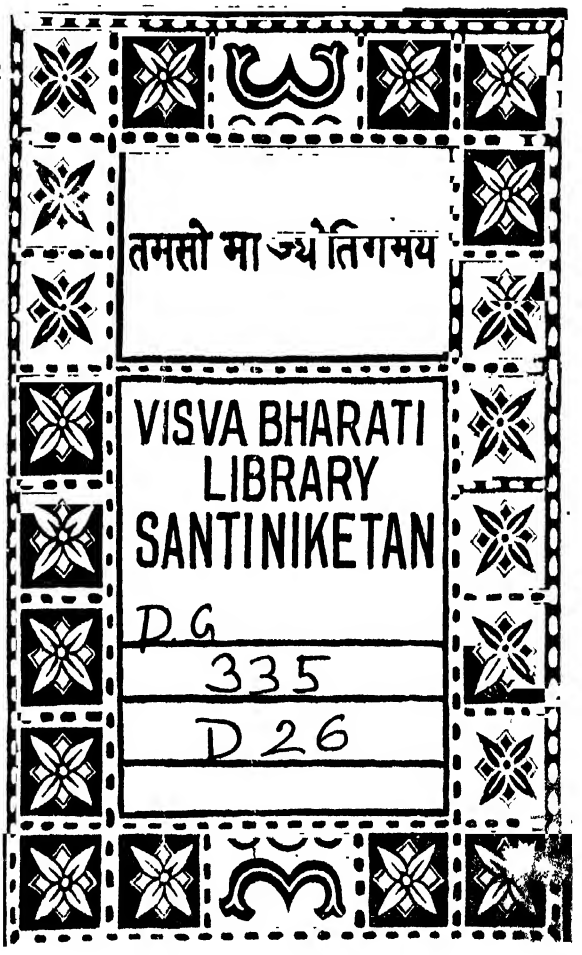
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MATERIALISM
MARXISM
DETERMINISM
AND
DIALECTICS

BY

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WITH FOREWORD
BY

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UNIVERSITY COLLEGE, LONDON.

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TO

DADA, SONADA, CHHORDA, SACHIN, MOHIT

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PREFACE

This small book is the result of some years of study on my part of the outlines of Indian Philosophy, Philosophy of the sciences and Marxist Philosophy. In my reading of the Indian Philosophy consisting of the main six systems: Mimāmsā, Nyāya, Vaisesik, Sāmkhya, Yoga, and Vedānta, I am struck by their boldness of thinking and their power of absorption. This independent thinking and power of assimilation were possible because they had an elastic attitude of mind. This elastic attitude for accepting all that is rational through centuries is the characteristic of Marxist philosophy too, which, however, stands for some clear-cut principles. There is a good deal of misunderstanding and wrong notions about Marxism due to scanty reading. It may also be observed that except true and unbiassed scholars, very few people care to read the necessary literature on the subject lest their preconceived notions get a rude shock. In this situation, this book has been written in concise form to enable a good section of people to get concrete ideas about Marxism and it is hoped that this small book compressed with the most important relevant topics may put an intelligent and inquisitive reader in the proper perspective in respect of the modern times.

I have begun this book with a discussion of the true meaning of materialism. The vulgar idea associated with materialism is a stress on grossness of things and in the words of Engels, " By the word Materialism, the philistine understands gluttony, drunkenness, lust of the eye, lust of the flesh, arrogance, cupidity, avarice, miserliness, profit-hunting and stock exchange swindling—in short—all the filthy vices." I believe that as soon as this vulgar idea will disappear from the reader's mind, Sāmkhya doctrines from the side of Indian Philosophy will make a strong appeal and in course of time and thinking, in a much more comprehensive way, Marxism will impress him most profoundly. The economic and political implications of Marxism have their roots in the philosophy. The philosophy of Contradiction and its allied aspect where higher synthesis occurs by the process of thesis and antithesis will to a large degree explain the phenomenal rise of socialistic thoughts; but a study of economic implications is equally essential.

The philosophy of Marxism has its strongest weapon—Dialectics. In the whole of Marxist philosophy, probably no expression is

more subtle, more terse and more meaningful than the expression Dialectics. This small book has made a serious attempt at elaboration of dialectician's attitude. Naturally it has involved me in the study of Planck, Einstein, Max Born, Eddington, Jeans, Heisenberg, Haldane, Bohr, Dirac, Huxley, Russell, Gamow etc., whose works throw some light on the subject. I have accordingly given a running foot-note from page 65 to 106 indicating the landmarks in the evolution of the Quantum theory and the Relativity theory. I have also expressed in this book what I have felt I have to say in respect of our attitude towards this changing world. During my work, I read the foot-note to Dr. R. C. Majumdar, M.Sc., Dr. Phil. Nat., of the Delhi University who had the privilege of working with Heisenberg and Bohr for sometime. I am deeply grateful to him. Upon my writings he has given suggestions and in many cases explanations very patiently to a layman like myself, and hence the full responsibility for this footnote is entirely mine. In writing it out and in building the procession of scientific events I had naturally to spend a stupendous amount of energy and the running footnote has been to me the most invaluable

matter—only next to the chapter on Marxism —upon which I have tried to construct the true meaning of dialectics. Still I am fully aware that I cannot confine the implications of dialectics in a description by words. Prof. J. B. S. Haldane's "Marxist Philosophy and the Sciences" is a masterly presentation of the application of dialectics which the true scientists will understand. The pseudo-scientists who sit in the laboratory but think of the ancient ideas as true for all times and are guided not by objective situation but by fixed ideas and rigid thoughts may still do science but cannot remake the society which is the true duty of Man. If ancient science and achievements, instead of being regarded as milestone of knowledge, govern our present thoughts and actions in the field of economics and politics, then the people can only be saved from inaction and ruin by a complete change of attitude. Vain restlessness and romantic dreams contribute nothing to progress.

I am deeply grateful to Prof. J. B. S. Haldane for his kindly writing the foreword.

Lucknow,
15th April, 1945. B. N. DASGUPTA.

FOREWORD

It is a great pleasure to write a foreword to Mr. Dasgupta's book. Marxism is the philosophy which guided Lenin, Stalin, and other great men who built the Soviet Union. Many people outside the Soviet Union believe that it can help them also to solve their practical and intellectual problems. In India that number is growing very rapidly. Marxism is primarily concerned with change, and India is on the brink of great changes; political changes which will include Swaraj, but will not be complete when self-government is achieved, and also economic changes. Marxism will show its Indian students how these changes can best be achieved.

Unfortunately Marx knew very little of Indian philosophy, and Mr. Gupta has done a great service not only to Indian but to European readers by showing the relation of Marxist ideas to those of the Samkhya and other Indian philosophies. From what little I have read of Indian philosophers (and a man who, like myself, knows no Sanskrit, or even Pali,

cannot obtain a very deep understanding of them) it is clear that some of the most characteristic ideas of Marxism, and particularly Marxist dialectics, will be more easily understood by Indians who are familiar with the thought of their countrymen than by many Europeans. It was not an accident that an Indian, Saha, first saw that the spectra of stars do not reveal the abundance of different kinds of atoms in their atmospheres, but the frequency with which they undergo certain changes, a thoroughly dialectical notion.

I have no doubt that the Marxist dialectic will not only be studied but developed in India. There is even perhaps a danger that Indian Marxists may be tempted, like the champak tree in spring, to put out the flowers of theory before the leaves of practice. However I am sure that Mr. Dasgupta will pardon me if I point out that his valuable book only deals with certain aspects of Marxism. Half of it is taken up with a very interesting account, on Marxist lines, of modern scientific developments. I sympathise with him. Marxism has recently led me to put forward theories which, if they prove to be truer than those of the past, will be of great importance

for Astronomy and Geology. But it has also led me into practical activities which, I hope, have done something to bring nearer the attainment of independence and democracy for India.

In conclusion may I hope that Mr. Dasgupta will find time to write a much larger book in which he will not only trace the relation of Marxism to Indian thought in greater detail, but make what may be a fundamental contribution to history by showing how changing social conditions have influenced the movement of thought in India. Kapila, Gautama, Samkara Acharya, and other great Indian thinkers were not isolated individuals. They were the finest products of great societies, and we can only understand them by understanding these societies. Such an understanding will be of great value, not only to India, but to the whole world.

University College,
London.
July, 1945.

J. B. S. HALDANE.

CHAPTER I

MATERIALISM

MATERIALISM in India is popularly known as Chārvāk philosophy. It existed before Chārvāk too—it was then attributed to Brihaspati and used to be called Lokāyatavād (or Atheism, Nāstikavād). It has thus come down to us from ancient times. In Europe too in the modern times, materialism has gained much ground but it is most of all in Russia where materialism has saturated the people and has become very powerful as a social force. Leaving Russia apart, materialism in Europe and that in India known as Lokāyatavād have almost the same significance, *viz.*, whatever is beyond our sense-perception is an unnecessary and futile assumption and hence God, Rebirth, Moksha, Soul etc., are of no consequence. In Russia, however, materialism has taken a different meaning. Marx has expressed it in his own philosophical way and dwelt upon its significance. He has discussed it thoroughly in all its aspects, and being a philosopher himself, he has given a consistent interpretation

of Philosophy, History, Economics and the phenomenal universe, and has indicated the subtle laws and the principles that underlie Nature including society.*

A study of the Materialism in India and that in Russia†, and a clear exposition of their differences must be of great interest if true understanding of them is considered necessary and it cannot be doubted that a necessity does exist. But there are difficulties in such a study; and the formidable difficulty lies in the utter lack of literature on Chārvāk Philosophy or to be more correct, Lokāyatavād Philosophy. Brihaspati and Chārvāk were materialists and their materialism refers largely to Atheism or Nāstikavād which has been interpreted in different ways--some hold that

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* In this great work of Marx, Engels had been his collaborator for forty years. Engels' share, in building up this philosophy, is in no way less, though the basic principles had been put forward by Marx. In fact, Engels is responsible for some formulations independently particularly in the realm of sciences while Marx in the realm of history of Society and Economics. Engels says " Marx stood higher, saw farther, and took a wider and quicker view than all the rest of us. Marx was a genius ; we others were at best talented. Without him the theory would not be what it is to-day. It therefore rightly bears his name."

† Marxian Materialism.

it is absence of belief in God and others hold that it refers to the non-acceptance of the divine origin and authority of the Vedās.‡ The Mimāmsakas believe in the Vedās but not in God; while the Buddhists and the Jainas believe neither in God nor in the Vedās. It is the latter school which has these common points with Chārvāk philosophy, and yet the difference between them is vast.

Thus all schools of materialism are agreed on one point, viz., they deny the existence of a Creator-God; they also do not admit the existence of anything divine—they believe in material things only. Thus the Indian Materialists represented by Chārvāk school and the European Materialists are only concerned with negating God and Scriptures but the materialism in Russia under the Marxist philosophy has struck an altogether new line of thought. The Marxist Materialists did not enter into speculation about God and creation, but built up their philosophy clearly distinguishing it from all Metaphysics and Idealism. The idealists hold that only our mind exists and that our being, the phenomenal

‡ The third view is that Nāstika is he who does not believe that Karma has any effect.

world, and changing Nature exist only in our sensations, ideas and in our mind. They also hold that there is a fixed ideal independent of everything including the material conditions or to put it in another language—they hold that the Creator, in His inscrutable ways, works upon a fixed plan and following an absolute law. The Marxists, however, believe neither in a fixed plan nor in any absolute law. They do not look upon things in their isolation but see them in their relations and in the process of change and development and hence their law is a law of motion, change and progress. In order to understand the distinction between the Materialists' and Idealists' position, the question has to be answered: "Did God* create this world

* "After a period of such chemical emergence came a great step. Some system of atoms attained a new degree of complexity and life emerged. 'Life' is the word with which we sum up the peculiar qualities and properties that emerged on that occasion. There was nothing added from outside the system; no new elements entered it, no new energies or forces played upon it from outside; the new kinds of relatedness of the atoms and energies within the system sufficed. As these new intrinsic relations were established, the system began to exhibit the complex of qualities and properties that we call life—irritability, conductivity, power of growth, assimilation, metabolism, generation, regeneration

or has it been in existence from eternity?" The Idealists replied : It was God who created the Universe—Spirit, Idea or Thought came first and then Matter or Nature (Prakriti) meaning that the idea (spirit) has the primacy of existence and the material world is a reflection of that idea. But the Materialists, on the contrary, regard Matter as primary and Idea or Thought as secondary. Thus they maintain that thoughts and ideas take shape with the different combinations of conditions of existence, economic environments and ultimately the modes of production. Again the Idealists believe that there is some kind of ultimate liberation or Nirvān or Moksha or complete absorption into Brahma, while the Materialists believe no such thing.

and all the rest. After an interval, long or short, during which living systems became more complicated, the new complications at last rendered possible further new kind of relatedness and there emerged sentience, the forerunner of mind. Further complications ensued (again with new kinds of relatedness), cognition emerged and Mind for the first time appeared upon the scene. Then slowly those systems in which mind had emerged increased in complexity of organisation and new forms of experience emerged. Thus the process continued up to the emergence of the higher forms of intellect and moral personality." (McDougall's *Modern Materialism*).

The latter do not believe in any Creator and maintain that this universe has been there from eternity, that it is perpetual and hence any attempt at a cosmology is baffling and a pure speculation.

It has just been stated that the Lokāyatas, the Buddhists and the Jainas do not believe either in God or in the Vedas; neither do the Marxian Materialists believe in God or Scriptures. But there are great differences in the former group itself. The Lokāyatas believe that life is the chance outcome of four (not five) primal substances, *viz.*, earth, air, fire and water and that life exists no more in any form after death. Hence they believe in enjoyment of life but all the same, have certain rules of conduct for life; the so-called materialists of Buddhist and Jaina faith believe not only in the rules of conduct for life, but believe in spiritual life, a stage after death until Nirvan, and with that end in view, they have developed their system of philosophy. Thus we see that subtle differences exist which ultimately become fundamental for our purposes. The Marxian materialism could no more keep company with Indian materialism because Buddhism even took a different line of deve-

lopment by the belief that there are levels of consciousness and there is spiritual life after death and also rebirth etc. This clearly indicated a system of idealism* and so it ceased to be materialism.

The Marxists by giving the primary place to matter explained that man's actions and thoughts are fashioned by his material existence. These materialists have made considerable progress along this line of thought and have cleared much of the vagueness

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"But the most important protest against the Upanishadic thought that is to be found in the view that was enunciated by the Buddha consists in his radical denial of the existence of self. There was no ātman as a permanent entity, individual or being. What appears as self is only the aggregate of different elements such as the body and the senses, the feelings, conceptual knowledge, the synthetic functioning of combined sense.affections, combined feelings and combined concepts of the consciousness. Interpreting it according to later explanations, we find that the early Buddhistic thought was radically pluralistic..... This early phase of Buddhism was thus a system of pluralistic phenomenalism, which did not attribute any greater importance to mind than to matter.....It may thus be difficult to conceive how from this doctrine there can originate any system of idealism, monism or absolutism but a little inspection will show that this elimination of all substantiality and reality from the elements which are supposed to compose the so-called individual took away from them the basis of realism or realistic pluralism." (S. N. Das Gupta's *Indian Idealism*.)

that surrounded our knowledge. This philosophy based on actual life which reflects material environments gives a consistent interpretation to our thoughts and actions and thus mainly concerns itself in the problems of life and living which comprise history of society, economic phenomena, political phenomena and scientific phenomena.

So far, we have seen that all those faiths under the general label of materialism can hardly remain together any longer, for, each has shown its own peculiarities and development. The only one which is an unmixed materialism in India is Lokāyatavād but that too has neither any intellectual nor philosophical depth. This impression is due to lack of literature—the writing of any literature being avowedly against their fundamental article of faith. The Lokāyatas did not formulate any set theories or doctrines lest these doctrines in later years would become a kind of scripture for all future times. This is why they are said to have deliberately left no literature except a meagre one and that too mainly in self-defence. Their philosophy consists of a code of moral life while emphasizing worldly enjoyment and happiness. We had better

leave the Chārvāks here for their philosophy does not, for the above reasons, throw light in our present quest.

At this stage when both Buddhism and Lokāyatavād are out of the picture of the philosophy of materialism, the ground is clear for the emergence of Sāmkhya, for, Sāmkhya to me is the only Indian materialism which has created a profound philosophy worth a critical study although it does not usually go under the label of popular materialism. Our aim now, therefore, will be to find out how far the Lokāyatavād, Buddhism, Sāmkhya and Vaiśeṣik systems differ from each other and Marxism in their basic concepts. To evaluate these systems of thought by external resemblances is to judge with a thin intellect. To gain a correct understanding of the philosophy, we must analyse the inner principles and the basic ideas. The basic philosophical concepts apart from their metaphysical subtleties are Satkāryavād (सत्कार्यवाद) and Asatkāryavād (असत्कार्यवाद). While analysing these two concepts, we shall try to determine the place that the concept of Marxism may be assigned in the context of the Indian Philosophy.

Satkaryavad

Satkāryavād is the basis of the Sāmkhya system. According to the Satkāryavād, the effect is inherent in the cause—it is inherent in the previous stage—only it appears in different forms and combinations. Sāmkhya says that Nature (or matter) is everchanging and everything in this universe is in motion and changing. Hence an altogether new matter is neither created, nor is any matter completely destroyed. Sāmkhya, as a complete philosophy, is dualist (Purusha and Prakriti) in its main principle, but the emphasis is on Prakriti as the unfolder of the universe and thus revealing its material character. That the effect is inherent in the cause is emphasised by the Satkāryavādists when they point out that oil comes out of the rape-seed because the oil is latent in the seed. If it was not latent, it could not have come into existence; so also, the pot was latent in the clay in some form, that is why it could be produced out of the clay (of course, the potter was necessary as a means* not as an ingredient). Likewise, it can also be

* Means is निमित्तकारण, ingredient is उपादानकारण.

said that cloth was potential in the thread, the weaver only revealed it by combining them and weaving them together. Satkāryavādists argue that cloth is produced out of the thread—it cannot be produced out of the clay because the special ingredients of cloth are not inherent in the clay. They thus prove that the effect is inherent in the cause —that the effect is only another form of cause, that there is some causality—that is "like causes produce like effects". In other words, there is no place for miracle or supernatural agency—there is occasion for wonder all the same. If an effect cannot be explained, it is because of our imperfections of knowledge—nothing else. This theory of Satkāryavād has been expressed exactly in the same language by subsequent philosophers. "Development is the coming to light of what is latent and hidden, or, as Aristotle would say, it is the transition from potential to actual being, or, in Hegel's words, it is the passage from the implicit to the explicit."*

Two points emerge from the Satkāryavād concept of Sāmkhya. First, that in

* Indian Philosophy by S. Radhakrishnan

a dualist philosophy where Purusha is the attributeless Witness and the unchangeable Consciousness, Prakriti (Nature) is the everchanging matter in perpetual motion presenting to the Conscious Witness all the experiences that Nature can lay before the Purusha through the unfolding and transformations; and second, that the law of causality is an indisputable fact and that creation is nothing but the implicit transformed into the explicit. The emphasis is thus complete that *like causes produce like effects.*

Asatkaryavad

Asatkāryavād is the basis of Buddhism and Nyaya-Vaisesik philosophy. It develops its own theory of creation and evolution as against Sāmkhya. The Asatkāryavādists hold that two or more atoms combining together, in a gradually increasing number, have resulted in this endless creation. They maintain that the effect is not necessarily implicit in the cause, it is a new creation out of two or more atoms, thus the effect is not always traceable into the cause—hence it is not necessarily a case of the implicit passing into the explicit. To them, atoms are innumerable and they

are the primary ingredients of creation and evolution, hence the theory is known as Atomistic Pluralism of Vaisesik. According to them, the atom is the last indivisible state of matter, it is inorganic in that indivisible state, for, so long as it is divisible, inorganic state cannot be stated to have been reached. At last when it has become inorganic by the final stroke of division, the problem arises "how can such atoms combine ? For, inorganic things cannot combine" On the other hand, if it is organic, then combining is possible but while it is possible, is it then atoms as defined just now that have combined ? or, organic things which surely are not atoms ? For so long as it is in the organic state, the state is the state of divisibility and divisibility implies destructibility. Thus the Asatkāryavādists are faced with the inherent fallacy of their theory. However, the difficulty may disappear if combination is supposed to be possible even in inorganic state.

As atoms are innumerable and there is going on constant and ceaseless combination of these atoms, creation and evolution can thus be simply explained. Hence the

other theory of "effect implicit in the cause" is not essential to them. The Asatkāryavādists, therefore, take their stand, for an explanation of the process of evolution, on this simple fact of plurality of atoms. In a theory which admits plurality, creation must needs be the combination of many and creation is everytime a new creation. It is not necessary for them to assume or accept that the effect is inherent in the cause. Ingredient A produces C with the help of B. Is it essential that C would be inherent in A? Asatkāryavādists would say, it may be; but if it is not traceable to A, it does not matter. The Satkāryavādists, however, would protest and assert that C cannot but be inherent in A, for, otherwise creation is impossible.

The Asatkāryavādists, therefore, find no ground to accept any relationship existing between cause and effect. Here then the law of Causality is rejected.* The Asatkāryavādists by their own theory, therefore, cannot predict or even indicate what new matter will be produced by the combination of two different substances. The character-

* Not necessarily if viewed in another light.

istics of the new matter may not at all exist in the causing substances. They maintain that each matter is a new creation—the clay and the pot, the cloth and the thread. They say it is ridiculous to suppose that the clay and the pot are in essence the same, simply because the pot has been made out of the clay—they say that the pot is a new creation—it never existed in the clay—its one ingredient is clay—that's all. The Satkāryavādists will answer "well, suppose that the cloth was not in the thread, but certainly it is the cloth and not the pot that can come out of the thread. You cannot make earthen pot from thread." We thus see that according to Satkāryavād, a cause has a limited field of expression or activity, i.e., one matter can produce one particular class of matter or effect only. A mango seed cannot produce black-berries, it can only produce mango. Thus the essentiality lies in the mango seed (though air, water and other aids are necessary); thus effect is traceable to cause. But according to Asatkāryavād, the field of activity is vast, if not unlimited, for, if there is no cause and effect relationship, *any* matter can produce *anything*.

CHAPTER II

MARXISM

THE Marxist philosophy does not go into subtleties of this kind of fine logic-chopping which upto a point has a profound influence on correct thinking and upon which (Bengal School of Navya Nyāya) the later growth of Hindu philosophy largely depended. Logic-chopping for its own sake, however, is not only useless but leads to stagnation of cultural development, to narrow self-complacency and orthodoxy, if such narrow intellectual exercises are pursued without any reference to the structure of philosophy whether it is at all related to man's synthesis of thought and action, whether it is consistent with a logical interpretation of all happenings of phenomenal universe and whether it is in consonance with the cultural advance of man. We have many schools of philosophy which have done immense metaphysical thinking and have evolved their own schemes distinct from one another—so distinct that each one is self sufficient and a closed scheme which later on

naturally became a dogma. Marx was an empiricist and he tried to read the inner law of nature and social change and then formulated some broad principles to explain development and change in the universe.

Marxism holds: (1) That there is objective reality existing outside and independent of our mind or thought. To understand this, the question has to be answered: Is objective reality the source of perception? If the answer is 'yes', you are a materialist, and if the answer is 'no', then you are a subjectivist or an agnostic. Lenin in his *Materialism and Empirio Criticism* says:

"We ask, is a man given objective reality when he sees something red or feels something hard etc. or not? This hoary philosophical query is confused by Mach. If you hold *it is not given*, you, together with Mach, inevitably sink to subjectivism and agnosticism and deservedly fall into the embrace of immanentists ..... If you hold that *it is given*, a philosophical concept is needed for this objective reality and this concept has been worked out long long ago. This concept is matter. Matter is a philosophical category designating the objective reality which is given to man by his sensations and which is copied, photographed and reflected by our sensations while existing independently of them."

Lenin continues "Acceptance or rejection of the concept matter is a question of the confidence man places in the evidence of his sense-organs, a question of the source of our knowledge, a question which has been asked and debated from the very inception of philosophy, which may be disguised in a thousand different garbs by professorial clowns, but which can no more become antiquated than the question whether the source of human cognition is sight and touch, hearing and smell. To regard our sensations as images of the external world, to recognise objective truth, to hold the materialist theory of knowledge—these are all one and same thing."

The origin of knowledge will bring further clarity to this problem. To understand this, the question has to be answered: What is the source of our knowledge? Is it objective natural law or properties of our mind and its innate faculty of apprehending certain *a priori* truths? Lenin says: "The recognition of objective law in nature and the recognition that this law is reflected with approximate fidelity in the mind of man is materialism."* The countless phenomena of

* "The Vaibhāsikas are natural dualists who maintain the independent existence of nature and mind. Epistemologically this theory is a naive realism.... The objects have an existence independent of our perception." (Radhakrishnan's *Indian Philosophy*.)

nature have to be comprehended by man by conceptions of order, purpose and law. First, they exist in nature, afterwards, human reason comprehends them—the reverse is not true viz. they do not exist in nature as reflection of their primary existence in the mind of man.

"Order, purpose, law are words used by man to translate the acts of nature into his own language in order that he may understand them. Those words are not devoid of meaning or of objective content; nevertheless, a distinction must be made between the original and the translation." (Lenin).

Still a great idealist Karl Pearson exclaims "Man is the creator of natural law." He says :

"The laws of science are products of the human mind rather than factors of the external world."

It is clear that it is a very superficial examination of facts which does not stand any scrutiny.

(2) That matter or nature is primary and spirit, idea or thought is secondary. The evolution of matter into life and then sentience and finally into mind is sufficiently illustrative of the fact. Natural science today corroborates in its every page that earth existed prior to man. In Marxism, there is no place for Absolute Idea or Universal

Spirit ; but thereby it does not reject spiritual life which, in Marxist philosophy, means cultural life. Spiritual life is the result of social and political ideas, views, theories and institutions existing at the time in society. Our ideas and thoughts are the reflection of our material being—not the other way about.

(3) That the world is not a world of "things-in-themselves" and that it is not reasonable or rational to think that the laws of the world are unknowable as the Idealists believe. While Kant believes with the Idealists in " things-in-themselves," Marxists believe in "things-for-us."

(4) That every matter, thought, system or condition has in it the germ of its opposite; and as a result of the contradiction or conflict, new creation continues in an endless series. When any existing order is in impact with another, a change takes place and the change has to be studied in the light of dialectics. Such an application of dialectical materialism upon all the social changes gradual or otherwise is called historical materialism or materialist conception of history. Such a study of history of society and of its growth gives the correct vision to observe the world

of transformations and to place human activities in the proper perspective. There is yet another subject of study with the help of dialectics—the study of thought-processes and thoughts—thoughts being also traceable to matter.* Engels writes in his *Ludwig Feuerbach :*

"We cannot get away from the fact that everything that sets man acting must find its way through their brains—even eating and drinking, which begins as a consequence of the sensation of hunger or thirst transmitted through the brain, and ends as a result of the sensation of the satisfaction likewise transmitted through the brain. The influences of the external world upon man express themselves in his brain, are reflected therein as feelings, thoughts, instincts, volitions ..... "

Thus all are traceable to brain which is a product of matter in its refined form. All these are liable to change and the changes are not mysterious, not metaphysical but material and of dialectical character. This material

* "That the material, sensuously perceptible world to which we ourselves belong is the only reality; and that our consciousness and thinking, however supra-sensuous they may seem, are the products of a material, bodily organ, the brain. Matter is not a product of mind but mind itself is merely the highest product of matter." Engels' *Feuerbach*).

change is at once dialectical because (a) change is the essential quality of matter (b) it offers certain generalisations in regard to changing matter, the most important of which is the fact that the opposite potentiality is implicit in the previous state and (c) it offers the clue to human effort to translate the natural change from its unconscious character to the conscious one. It is dialectical materialism because dialectics refers to the attitude, mode and method of study and materialism refers to the character of the contents of the nature and the world.

To understand dialectical materialism, one must understand dialectical idealism of Hegel. The credit of discovering and employing dialectics in the form of an efficient tool in the interpretation of the universe must be given to the master-mind of Hegel but the change from idealism to materialism has been solely due to Marx and Engels but not without some amount of clarification from another eminent philosopher Feuerbach who serves as the link between Hegel and Marx. Engels in his *Ludwig Feuerbach* writes:

> According to Hegel, therefore, the dialectical development apparent in nature and history, i.e., the

causal interconnection of the progressive movement from the lower to the higher, which asserts itself through all zig-zag movements and temporary set-backs, is only a miserable copy of the self-movement of the concept going on from eternity, no one knows where, but at all events independently of any thinking human brain. This ideological reversal had to be done away with. We comprehended the concepts in our heads once more materialistically—as images of real things instead of regarding the real things as images of this or that stage of development of the absolute concept. Thus dialectics reduced itself to the science of the general laws of motion—both of the external world and of human thought—two sets of laws which are identical in substance, but differ in their expression in so far as the human mind can apply them consciously, while in nature and also up to now for the most part in human history, these laws assert themselves unconsciously in the form of external necessity in the midst of an endless series of seeming accidents. Thereby the dialectic of the concept itself became merely the conscious reflex of the dialectical motion of the real world and the dialectic of Hegel was placed upon its head; or rather, turned off its head, on which it was standing before, and placed upon its feet again. And this materialist dialectic which for years has been our best working tool and our sharpest weapon was, remarkably enough, discovered not only by us, but also independently of us and even of Hegel by a German worker, Joseph Dietzgen.

The Law of Dialectics can be given more concrete form in the following three laws:—

(*a*) Law of transformation of quantity into quality and *vice versa*,

(*b*) Law of interpenetration of opposites,

(*c*) Law of negation of negation.

(5) That the basic position is the non-acceptance of Idealism which *inter alia* maintains the existence of eternal truths. In the realm of Mathematics, Astronomy, Physics and Chemistry which are called exact sciences, they are going through so much of controversy, assumptions and transformations that they are presenting always new problems and also meeting ever new solutions and thus passing through a process of dynamic character. In the realm of Biology, the numerous investigations presenting numerous inter-relations have occasioned luxuriant growth of hypotheses and while making gigantic strides are also passing through a continuous process. Eternal truths in this domain cannot be anything but platitudes like "all men are mortal, all female mammals have mammary glands and the like; he will not even be able to assert that the higher mammals digest

with their stomach and intestines and not with their heads, for the nervous activity, which is centralised in the head is indispensable to digestion."* In the realm of historical sciences, change, growth and progress are the essential features visible in every observable phenomena and hence in this domain, Engels says, eternal truths† will again be platitudes like: "man cannot live except by labour;

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* Engels.

† The conceptions of good and bad have varied so much from nation to nation and from age to age that they have often been in direct contradiction to each other. But all the same, someone may object, good is not bad and bad is not good; if good is confused with bad there is an end to all morality, and everyone can do and leave undone whatever he cares. This is also, stripped of all oracular phrases, Herr Dühring's opinion. But the matter cannot be so simply disposed of. If it was such an easy business, there would certainly be no dispute at all over good and bad; everyone would know what was good and what was bad. But how do things stand to-day? What morality is preached to us to-day? There is first Christian—feudal morality, inherited from past periods of faith; and this again has two main subdivisions, Catholic and Protestant moralities, each of which in turn has no lack of further subdivisions from the Jesuit-Catholic and orthodox-Protestant to loose "advanced" moralities. Alongside of these we find the modern bourgeois morality and with it too the proletarian morality of the future, so that in the most advanced European countries alone, the past, present and future provide three great groups of moral

that up to the present, mankind for the most part has been divided into rulers and ruled; that Napoleon died on May 5th, 1821 and so on." To add a few more platitudes which are introduced at times by way of sophistry—viz., Calcutta is in India or two and two make four.

Once the idea of eternal truth and fixed concepts gets a permanent place of sanctity in us, the elasticity of the mind begins to disappear. This is bound to cause stagnation and even decay. History will provide innumerable instances where a great idea or work has suffered being in conflict with the then fixed idea. Even to-day there are social thinkers who, not being

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theories which are in force simultaneously and alongside of one another. Which is then the true one? Not one of them, in the sense of having absolute validity; but certainly that morality which contains the maximum of durable elements is the one which, in the present, represents the overthrow of the present, represents the future: that is, the proletarian. But when we see that the three classes of modern society, the feudal aristocracy, the bourgeoisie and the proletariat, each have their special morality, we can only draw the conclusion, that men, consciously or unconsciously, derive their moral ideas in the last resort from the practical relations on which their class position is based—from the economic relations in which they carry on production and exchange.

with the common crowd, have clashed against the traditional views and therefore, for them, it is extremely difficult to make much progress against the fixed ideas which are held as eternally true. While it is contended here that fixed concepts under the name of eternal truths over the unit of a long period are untenable, it is by no means contended that moral conceptions and truths over the unit of a short period do not exist—they are the guide, for a particular time, of our material welfare and moral conduct. The unit of such time is however relative according to social conditions, and its validity ceases with changed circumstances. A little thinking will show that an elastic mind ready to accept all that is rational would be a priceless asset to the society at any time. Such an elastic attitude is only possible if it is accepted as a part of nation's philosophy. Rational attitude fully conscious of the objective situation requires far greater intellectual and moral stamina than the attitude of fixed concepts and of emotion. Emotional approach to social problems has to be discarded and rational attitude must take its place. A careful analysis

will ultimately show that eternal truths in the sense in which the words "eternal" and "truth" have been understood by the idealists are fictions.

(6) The source of knowledge is the unity of theory and practice. Materials for knowledge lie in our experiences of this world. This, however, does not mean that experience presupposes existence of all things and ideas—that would be the view of mechanical materialism. The interactions of different experiences and ideas may give rise to new ideas not necessarily physically experienced but such ideas are always traceable ultimately to previous experiences. Divine revelation, pure thought or intuition as sources of knowledge are myths. The experiences of a man of which he is sometimes conscious and sometimes unconscious but which he is acquiring every moment of his life are the materials out of which ideas are formed, theories are set up; when he tests them they become scientific truths. This testing establishes the unity of theory and practice. A scientist and a philosopher can recall into practice experiences of which he is the conscious possessor, but what is called divine

revelation of a seer is nothing but unconscious experiences which are caught in his extremely sensitive and refined mental apparatus and used for creative purposes. When intuition is said to be responsible for a great work or discovery, it is always a scientifically trained mind which works behind this so called intuition. When Newton saw the apple fall it was not intuition as some may love to think—he saw the apple fall many times before and when he discovered gravitation, he also gave some hard mathematics in the laws of motion which clearly indicates that his mathematical genius was at work. When pure thought is said to be responsible for a scientific discovery or any creative work, it is in fact a body of experiences analysed and assimilated with a high degree of intelligence and with a keen penetration of mind but applied unconsciously with one's own freshness of outlook. Pure thought made a very considerable progress in man's cultural evolution. Observational power showed equally extraordinary range. The Charaka (caraka) and Susruta system of medical science (Ayurveda), Tantra physiology and

and anatomy, which are traceable to the Vedas and ancient literature, illustrate the richness and vastness of their experience, observation and analytical power. Again, Sāmkhya, Nyaya-Vaisesik systems laid down the basis of Physics and Chemistry in India thousands of years ago with comprehensive intellect and Mathematics and Astronomy grew as Vedāngas ; but most of these have become crude today. It was necessary for the successors of Kapila, Gautama and Kanāda to remember that the truth or falsity of any science, theory, formulation, etc., has to be judged by application to the test of nature and society. Nature and society are the ultimate reality. This is another Marxist message. But for those whose philosophy is that this human society in which they are born is of no essential value and that man is born to prepare himself for the other world, the idealist philosophy is superb. Idealist philosophy teaches man to be too humble—if there is a flood or famine it is supposed to be man's sin or God's will—if it is a domination of one over another, it will teach transitoriness of life and extend a hope for justice before the throne of God—if there is poverty and suffering,

it will teach that God has His inscrutable ways of perfecting man by passing him through sufferings. Thus the great idealist philosophy has no responsibility for man and society, it owes its allegiance to the other world. The most potent instrument of idealism is religious belief. It is true that in the past, religious beliefs played in some instances progressive role, it is equally true that it has served reactionary ends as history will testify abundantly. This is why we find that sections of people, in order to keep their vested interests intact, raise religious slogans. Marxian philosophy attacks the very fundamentals and regards religious groupings and narrow nationalism as reactionary from the point of view of a higher synthesis. It is true that idealism teaches many virtues and that many great men are idealists. But the main issue is that idealism teaches abstract virtues and marxism emphasises virtues attuned to society which alone can assure social progress. Thus idealist philosophy is not calculated to bring about a unity between thought and action whereas in Marxian philosophy the two are mutually dependent and correctives. Where great idealists have achieved

synthesis of ideal and action, they have only shown that man is greater than philosophy.

(7) That in every case of synthesis a conscious behaviour or effort or direction is an essential element. In the past many scientific discoveries have been made and social progress achieved by many acute minds of science and society but in many cases they did not fully realise their implications. In all the past, during the transition of society from one stage to another, they were not conscious that they were revolutionising the society--they were only realising that industrial labour was giving them greater advantages than agricultural labour and that their emancipation from the bondage of feudal lords lay in changing the mode of production, viz., agriculture to industry or from hand loom to power loom, etc. They, therefore, unconsciously rolled into another stage out of sheer necessity to save unnecessary labour and trouble. It is here that one should realise what tremendous advance in society would have been possible if a conscious effort in refashioning the society had been made. This is another Marxist message. "The element of conscious

effort is of profound significance as it is by this that society can be quickly and correctly changed. The interpretation of the society vis-a-vis nature is one aspect of marxism and the other aspect of the philosophy is to change the world by a conscious effort in the right direction. This conscious effort is completely missing in the mechanical materialism and also in all philosophies so far—western and eastern including Sāmkhya* and it is here that Marxian materialism becomes the greatest philosophy, if philosophy has any responsibility to man and society. Marxist philosophy includes nature and man in their ever new transformations and their mutual interactions leading to the highest development of society in which stage exploitation of man by man will stop and thus the spiritualism in its true meaning will be established.

(8) That everything has to be understood and examined in its environmental

*In the Nyaya-Vaisesika System all action of matter on matter is thus resolved into motion. Conscious activity (prayatna) is distinguished from all forms of motion as against the Samkhya doctrine which considered everything other than purusa (intelligence) to arise in the course of cosmic evolution. (S.N. Das Gupta's *History of Indian Philosophy*).

relations, relatedness and change and not in its isolation and fixity. Fixed and isolated categories have definitely proved to be unsound and since Physics, Chemistry and also historical sciences are leaning towards a study in their relations, they have yielded sounder results which fit in with the objective nature with much greater closeness.

(9) That all changes and progress in society are finally traceable to the modes of production. Geographical environment may explain events and things over a very long unit of time because geographical change takes place rather slowly. Another factor viz. growth of population has a great influence but it cannot finally determine the development of society for in that case countries like China and India would have effected radical changes long ago. It is, according to Marx, the mode of production which is finally responsible for development and progress of society. Mr. J. B. S. Haldane says "the scientific activities of any society depend on its changing needs and so in the long run on its productive methods and how science changes the productive methods, and therefore the whole society." Mode of pro-

duction refers mainly to three important factors (a) instruments of production (b) men who make use of these instruments (c) men's relations of production.

The theory that all development is ultimately traceable to the modes of production is the key to the understanding of Marxism particularly in respect of economic and political theories. Besides ill-equipped critics, there are impatient critics who try to misread the question of "modes of production" without going deep into it. Nobody can explain the position better than Engels himself who in 1890 wrote to Bloch:

According to the materialistic conception of history, the production and reproduction of real life constitutes in the *last instance* the determining factor of history. Neither Marx nor I ever maintained more. Now when someone comes along and distorts this to mean that the economic factor is the *sole* determining factor he is converting the former proposition into a meaningless, abstract and absurd phrase. The economic situation is the basis but the various factors of the superstructure—the political forms of the class struggles and their results—constitutions, etc., established by victorious classes after hard-won battles,—legal forms, and even the reflexes of all these real struggles in the brain of the participants, political,

jural, philosophical theories, religious conceptions which have been developed into systematic dogmas, all these exercise an influence upon the course of historical struggles, and in many cases determine for the most part their form. There is a reciprocity between all these factors in which, finally, through the endless array of contingencies (i.e., of things and events whose inner connection with one another is so remote, or so incapable of proof, that we may neglect it, regarding it as non-existent) the economic movement asserts itself as necessary. Were this not the case, the application of the theory to any given historical period would be easier than the solution of a simple equation of the first degree.

(10) That the theory* of evolution of Darwin and his successors is, for the interpretation of evolution and progress, the correct basis except in so far as Marxism believes in sudden changes or leaps at times while believing in gradual changes also. Engels in *Anti-Duhring* (1878) writes:

"In spite of all intermediate steps, the transition from one form of motion to another always remains a leap, a decisive change. This is true of the transition from the mechanics of celestial bodies to that of smaller masses on a particular celestial body; it is

* Marx however got the evolutionary conception sometime before Darwin established the theory of evolution.

equally true of the transition from the mechanics of masses to the mechanics of molecules—including the forms of motion investigated in physics proper: heat, light, electricity, magnetism. In the same way, the transition from the physics of molecules to the physics of atoms—chemistry—in turn involves a definite leap; and this is even more clearly the case in the transition from ordinary chemical action to the chemistry of albumen which we call life. Then within the sphere of life the leaps become ever more infrequent and imperceptible ....."

Continuing, Engels expresses indebtedness:

"at the colossal impetus which science owes to the driving force of the Darwinian theory. Neither Darwin nor his disciples among scientists ever think of in any way belittling the great services rendered by Lamarck ..... The theory of evolution itself is however in a very early stage and it therefore cannot be doubted that further research will modify in very important respects our present conceptions, including strictly Darwinian ones, of the course of the evolution of species."

True to the prophecy of Engels, the Darwinian conception underwent a modification. Julian Huxley in his *Evolution* writes:

"Hogben writes: The essential difference between the theory of natural selection expounded by such contemporary writers as J. B. S. Haldane, Sewall Wright, and R. A. Fisher, as contrasted with that of

Darwin, resides in the fact that Darwin interpreted the process of artificial selection in terms of a theory of "blending inheritance" universally accepted by his own generation, whereas the modern view is based on the Theory of Particulate Inheritance. The consequences of the two views are very different. According to the Darwinian doctrine, evolution is an essentially continuous process, and selection is essentially creative in the sense that no change would occur if selection were removed. According to the modern doctrine, evolution is discontinuous. The differentiation of varieties or species may suffer periods of stagnation. Selection is a destructive agency.

Accordingly, Hogben would entirely repudiate the title of Darwinism for the modern outlook, and and would prefer to see the term Natural Selection replaced by another to mark the new connotations it has acquired, although on his latter point he is prepared to admit the convenience of retention.

These objections, coming from a biologist of Hogben's calibre must carry weight. On the other hand we shall see reason in later chapters for finding them ungrounded. In the first place evolution, as revealed in fossil trends, is "an essentially continuous process. The building-blocks of evolution, in the shape of mutations, are, to be sure, discrete quanta of change."

About this discrete quanta of change which some have described, as 'sudden change' and others have described as a 'leap',

Plekhanov, an eminent scholar of Marxism writes :

"Many people confound dialectic with the theory of evolution. Dialectic is, in fact, a theory of evolution. But it differs profoundly from the vulgar theory of evolution, which is based substantially upon the principle that neither in Nature nor in History do sudden changes occur, and that all changes taking place in the world occur gradually. Hegel had already shown that, understood in such a sense, the theory of evolution was inconsistent and absurd."

The phenomenon of 'leap' is also visible in the transition of modes of production. It has been said that the development of society is ultimately traceable to the modes of production, but it has to be understood that external pressure at one's sweet-will and applied in a haphazard way cannot bring about a change in the mode of production. The new productive forces must grow from within. Marx in 1859 in his *Critique of Political Economy* writes:

"No social order ever disappears before all the productive forces for which there is room in it have been developed; and new higher relations of production never appear before the material conditions of their existence have matured in the womb of the old society itself. Therefore mankind always sets itself

only such tasks as it can solve; since looking at the matter more closely, we will always find that the task itself arises only when the material conditions necessary for its solution already exist or are at least in the process of formation."

At this nodal point, gradualness makes room for a jump and one will then say with Marx "Force is the midwife of every old society pregnant with a new one." Plekhanov says about jump :

"What ought to have been said was that history never makes jumps unless the way has been prepared for them. There can be no sudden change without a sufficient cause, and this cause is to be found in the previous march of social evolution. But, inasmuch as this evolution never ceases in societies that are in course of development, we may say that history is continually engaged in preparing for such sudden changes....."

Again, at this nodal point, it is the task of real geniuses to give the lead in the right direction with the full knowledge of past developments and future possibilities, to create a mentality for the future events—not to turn a society backwards in veneration of the past but to fashion and reinforce the activities of the society for the necessary radical transformation. True, the material

conditions are a necessity but Marx's third thesis on Feuerbach* is equally significant. Plekhanov writes:

"There Marx complained of the earlier materialists because they had failed to take into account the fact that, if on the one hand, men are the products of environment, environment itself, on the other hand, is modified by men. In Marx's view, therefore, the task of materialism in the domain of history was to explain exactly how environment can be modified by men who are themselves a product of this environ ment."

In this task of re-fashioning of environment, the part played by man's activities is so effectively described by Engels:

"Natural science as well as philosophy has completely neglected the influence of the activity of man upon his thinking. They know only nature on one side, thought on the other. But it is precisely the *changes in nature brought about through men,* and not nature as such alone, which is the most essential and primary foundation of human thought. In proportion to the extent to which man learned to change nature, his intelligence developed. The naturalistic

* Marx in 1845 wrote: "The materialist doctrine that men are products of circumstances and upbringing and that, therefore, changed men are products of other circumstances and changed upbringing, forgets that circumstances are changed precisely by men and that the educator must himself be educated....."

conception of history, found e.g., more or less in Draper and other natural scientists according to which it is nature which exclusively acts upon man, and natural conditions which exclusively determine his historical development, is therefore onesided. It forgets that man can react upon nature, change it, and create new conditions of existence."

In discussing the question of environment, evolution and progress as conceived by Darwin and Marx, it is necessary to clear a popular misconception. A group of scientists think that there is no sufficient reason to believe in progress—they only see change and at times, even not that. They hold that the theory of progress owes its origin to anthropomorphism, which is nothing but self-complacency. Their grounds are as follows:

(a) Adaptability—many forms of life e.g. jellyfish are as adaptable to their environment as bird or man.

(b) Stagnation—many forms of life have remained unchanged for millions of years.

(c) Retrogression—many forms of life show degradation of form and degeneration of function.

It is however admitted by all biologists that the evolutionary progress must connote two things :

(1) greater control over environment,

(2) greater independence over changes in the environment.*

These two criteria have been accepted to indicate the advance of biological progress or biological efficiency. Surely, man satisfies these two conditions much more than monkey, and it has also to be admitted that while a jellyfish may have the power of adaptability to its environment, it is certainly not equipped with potentiality of further progress.

It is a very common fallacy to hold that while there is change, there is no progress and sometimes it is a cheap fashion to pose a wise man by being a pessimist, and a conservative. There is however a little misunderstanding in stating the case for progress. The believers in evolution who are acquainted with the scientific advance of the present day will not contend that the pogress is universal and compulsory—what is con-

*Huxley's *Evolution.*

tended is that evolution is progress though not necessarily for each and everything of the world—there may be cases of stagnation, there may be cases of degeneration but all the same progress is general and unmistakable.

On a study of Marxism, these have struck me to be its broad and essential points —each point gives one aspect of it and all taken together make Marxist Philosophy. The first seven aspects may be said to represent what is known as Philosophical Materialism as against Philosophical Idealism or Idealist Philosophy. The last seven aspects may go to construct what is known as the general theory of Dialectics (being the comprehensive name for Dialectical materialism) which when applied to the study of society and its history is known as Historical Materialism. When dialectics (Dialectical materialism) is applied to natural sciences, in the words of J. B. S. Haldane:

" ..... Marxism will only tell a scientist what to look for. It will rarely, if ever, tell him what he is going to find, and if it is going to be dogma, it is worse than useless ..... Marxism proves of the greatest value in studying the development of science, and the relationship of the different sciences

to one another, particularly the relation of chemistry to physics, and of biology to chemistry. And it is particularly useful in those branches of science which are themselves concerned with change, for example, in the theory of evolution."

Elsewhere Haldane has said:

"Had Engels' method of thinking been more familiar, the transformations of our ideas on physics which have occurred during the last thirty years would have been smoother. Had his remarks on Darwinism been generally known, I for one would have been saved a certain amount of muddled thinking. I therefore welcome wholeheartedly the publication of an English translation of Dialectics of Nature, and hope that future generations of scientists will find that it helps them to elasticity of thought."

The economic and political implications follow from one or from the other aspects of Marxism. These implications have created much more commotion in the world than the philosophical doctrines of Marxism but they are rooted in the latter. The Marxian theory of value and the theory of class struggle have become the basis of world-wide thought and practice and Russia of late has remodelled its society upon socialism which is grounded partly upon the economic and partly upon the political theories.

Thus, according to dialectical materialism, all progress and development are brought about by inner contradictions* which are generated with their gradual growth. All things in nature and society have a past and a future, have a positive and a negative side. The struggle of these contradictions, the struggle of that which is dying away and that which is being born are the essence of progress and change.† The very intense contradictions will indicate the nodal points and will also explain the transition of stages from primitive communism to slave system, from slave system to feudal, from feudal to capitalist, from capitalist to socialist and from socialist to communist societies.

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* "Prakriti is the fundamental substance out of which the world evolves. In the unmanifested condition, Prakriti is but the union of opposites.....The Sämkhya conceives the supreme principle of the world as a unity with a real opposition of elements." (Radhakrishnan's *Indian Philosophy.*)

† "Buddha simply accepts the facts of experience. Things change. There is no being in the world but only becoming. In such a state, the supreme reality is the law of change." (Radhakrishnan's *Indian Philosophy.*)

CHAPTER III

DETERMINISM

As Marxism does not primarily concern itself with cosmology, the Marxists in explaining the creation hold, as the Vaisesikas and Budhists do, that two or more things combine to produce a new thing. It is a common phenomenon that when two colours mix, sometimes a new colour emerges. The emergence of this new thing is the subject matter of Lloyd Morgan's Emergent evolution.* The new product appears as a result of

* Oxygen combines with hydrogen and the properties of a molecule of water emerge; water with all its peculiar qualities and properties is an emergent, a novelty. It consists only of oxygen and hydrogen; but just because these are related to one another in a new way, the combination H_2O, exhibits emergent qualities. The molecule of water is formed by the combination of hydrogen and oxygen alone; no other element or factor of any kind enters into it; but it is not hydrogen and oxygen; it is water. In the combination, potentialities previously latent in the hydrogen and oxygen have been actualised, with the consequence that the molecule of water exhibits qualities and properties not exhibited by nor discoverable in hydrogen and oxygen in their pure state. The new kind of relatedness is intrinsic to the system ....." (*Modern Materialism* by McDougall.)

the mixture; but seen separately, neither of the two colours have in them the characteristics of the third colour. This is known as *Emergence*. Such emergence or leap apparently seems to be in the domain of the concept of Asatkaryavad but analysing the phenomena of colour scientifically it is found that this emergence of a third colour is nothing but the emission of one colour to the suppression or absorption of all the rest. Therefore essentially no new untraceable colour has arisen. According to more modern thought, colour is nothing but a phenomenon of wave-length or vibration and the emergence of a so-called new colour need not drive our conclusion to Asatkaryavad. Yet it may not be impossible to imagine the case of an altogether new creation.

When we have discussed the two Indian concepts with their full implications and after we have shown a strong bias in favour of Satkaryavad as a much sounder theory, it must be admitted that though the new product may be finally traceable to the causing substances, still, the product seems distinctly of a different order and it may be

placed in a different category if the creation of a third category (Satkaryavad and Asatkaryavad being the two) is accepted by the modern thinkers. Marxism in its aspect of social and political phenomena follows Satkaryavad and in its aspect of scientific phenomena too, it closely follows the same* but

* In one point, however, the history of the development of society proves to be essentially different from that of nature. In nature--in so far as we ignore man's reactions upon nature—there are only blind unconscious agencies acting upon one another and out of whose interplay the general law comes into operation. Nothing of all that happens—whether in the innumerable apparent accidents observable upon the surface of things, or in the ultimate results which confirm the regularity underlying these accidents is attained as a consciously desired aim. In the history of society, on the other hand, the actors are all endowed with consciousness, are men acting with deliberation or passion, working towards definite goals; nothing happens without a conscious purpose, without an intended aim. But this distinction, important as it is for historical investigation, particularly of single epochs and events, cannot alter the fact that the course of history is governed by inner general laws. For here, also, on the whole, in spite of the consciously desired aims of all individuals, accident apparently reigns on the surface. That which is willed happens but rarely; in the majority of instances the numerous desired ends cross and conflict with one another, or these ends themselves are from the outset incapable of realisation or the means of attaining them are insufficient. Thus the conflict of innumerable individual wills and individual actions in the domain of history produces a state of affairs entirely analogous

in many cases--to be more correct, in some cases, it may come within the fold of Asatkaryavad. Only to this very limited extent, Marxism may be called indeterministic. This indeterminism may also be due to imperfections of our present state of knowledge but there it is. Though these rebel phenomena show a leaning towards Asatkaryavad it must be remembered that with Satkaryavad they are originally connected by an umbilical chord.

Satkaryavad or the principle of *like causes produce like effects* has a strong hold upon the Hindu mind. The law of karma is based on this theory. In physical phenomena, the cause and effect relationship can often be demonstrated, i.e., effect can be traced into the cause but in the karma-domain, effect of karma or action cannot be physically analysed. It is only a conception,

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to that in the realm of unconscious nature. The ends of the actions are intended, but the results which actually follow from these actions are not intended; or when they do seem to correspond to the end intended, they ultimately have consequences quite other than those intended. Historical events thus appear on the whole to be likewise governed by chance. But where on the surface accident holds sway, there actually it is always governed by inner hidden laws and it is only a matter of discovering these laws.—(Engels' *Feuerbach*)

but based on the same logic. Let us see how that concept has been worked upon and with what results.

The Upanishads and Vedānta believe in the law of Karma, that is, they believe that man has in this life or after life just as he acts in the previous life or in this. They hold that it cannot be otherwise, and they hold equally firmly that each individual has the right or choice to do or not to do a thing, to act in one way or in any other; that is, every one has a Free-will. Thus on the one hand, there is the inevitable effect of Karma ; on the other hand, there is the free-will. It is in this way that in the past a belief in re-birth became necessary. The law of karma operates through a series of births and it is free-will which determines one's action and the merit of the action gradually exhausts or reduces the continuity or chain of births. At the same time, free-will may lead man from one action to another with the result that instead of exhausting, the series may be further lengthened. The Vedantists hold that man has to suffer the consequences of his actions until he succeeds in regulating his actions by true knowledge and wisdom.

For the Vedantists, this law of karma and free-will are not creations of a fanciful imagination, neither is it a case of false solace designed in intense speculation; no, they have to be postulated as such, unless, our acts and doings are taken to have absolutely no significance, no effect and no merit or no demerit. It is because of this that the Hindu had to accept the idea of previous birth and future birth, otherwise, he could not explain the destiny of man and all the differences, disparities and contradictions inspite of apparently equal dose of effort and will. Upto a point, environment economic and otherwise would explain but beyond a certain point, explanation becomes one of chance or accident. If causality is not accepted, then accident is irresistible as the only explanation. But is the explanation of accident any better and any more scientific than series of births? After all, both are postulations. They say that to accept accident as explanation is to avoid the question by a mere phrase—it is just an evasion in the face of a problem whose explanation requires a wisdom of a superior kind. In truth, it is not an explanation of the problem

of life, not even an acknowledgment of imperfections of present state of knowledge but it is merely winking at the problem itself—solution remaining far distant. The inequities, disparities, differences, distinctions compelled the ancient mind in this way to believe in previous birth i.e., just as, on the one hand, we have 'karma' leading to their inevitable results, so we have free-will which has the full power of controlling our future actions. Actions, however, are not inevitable or predetermined. Planck says "It is a dangerous act of self-delusion if one attempts to get rid of an unpleasant moral obligation by claiming that human action is the inevitable result of an inexorable law of nature." It seems clear that Hindu philophy does not regard life as predetermined; and that life follows a fixed pattern. None of the actions of a man in this life is predetermined. Only, once he has done an act he must get the inevitable result of his own action. Thus there is free-will to act or not to act, but once the act is done, the law of karma will bring its own result. There is no escape from the inevitable consequence of action but by exercise of free-will, man may guide his future

and thereby create his own destiny. While all the systems of philosophy accept this position, it is only Visishtā-dvaitavād which could not accept fully the idea of free-will. It is not at all surprising that the Visishtādvaitavādists whose philosophy is the self-surrender to God should believe that even their free-will is predetermined by God. They believe that all actions are done according to God's will. Hence the actions of a man who has surrendered himself to God, are beyond any valuation by merit or demerit. Not one among the different systems of Hindu philosophy denies free-will and freedom of action to man. The Visishtadvaitavād system alone connects these with God's will. Talking about our Free-will, they only say, as the great philosopher said, that "A stone in the air would think itself free if, it could forget the hand that had thrown it." In this connection the interesting and commonly used terms are Adrasta and Fate. They are nothing but consequences of our actions which we do not remember in this life and are untraceable in this birth. The result of our unknown actions is what we call fate. Here also the law of karma indicates the

cause and effect relationship. It is thus clear that the theory that particular causes produce some particular effects has gone deep into our being. This is why the Satkāryavādists are strengthened in their belief that the effect is implicit in the cause. On the contrary, the followers of the doctrine of Asatkāryavād do not believe in this cause and effect relationship. They hold that it is impossible even to foresee the probable lines of the effects which some causes are likely to produce. This uncertainty or lack of relationship of cause and effect has apparently some similarity with Marxism. For, a particular condition or thought, in Marxian dialectics, in its impact with another condition or thought, changes qualitatively, and it gradually progresses with every qualitative change. How an objective situation will change and what shape it will take, all these will depend on the conditions with which it comes into conflict. The objective situation will change according to the nature of the impact, character of action, thought and direction. Hence it is impossible to foretell what shape the synthesis will take. This uncertainty may look like break-down of causality which means

Asatkāryavad. But it must not be concluded from this that any condition or thought can immediately transform into *any* shape. The possibility of this kind of unpredictable* change is not so much limited in social and political spheres of life as it is in the domain of science. A serious conflict of thoughts may produce unthinkable changes almost untraceable. But it will be wrong to say from this that any cause can produce any effect. In truth, whatever is latent in our political and economic life, that only is revealed, that only takes a new form which was lying dormant but capable of being enlivened under efficient directing force. Humanity has a possibility of progressing in many directions and in many ways because the social and political life carries varied degrees and varied phases of current and dormant ideas and possibilities capable of development in different directions. Social and political development, therefore, rest essentially upon the Satkāryavad concept.

* We live in a fairly neat part of the Universe where the planets go round our sun very regularly. But many parts are crowded with stars .... Where any planets would soon be thrown out of their orbits (J. B. S. Haldane).

Scientific research of the nineties has shown the indissolubility of the cause and effect relationship. It means that certain particular causes combine to produce certain particular effects. This is known as Determinism. It means that the same causes under same conditions can be predicted to yield the same result and hence the result is pre-determined. Jeans writes :—

" Thus, as Laplace pointed out in his Essay on Probability (1812), the present state of the world may be regarded as the effect of its antecedent state, and also as the cause of the state that is to follow. He went on to say that if the state of the world at its creation were specified in its minutest details to an infinitely capable and infinitely industrious mathematician, such a being would be able to deduce the whole of its subsequent history. Nothing would be uncertain for him; the future as well as the past would be present to his eyes. Even though no such mathematician exists, the whole future history of the world must have been implicit in its configuration at its creation; its so-called evolution is a mere unrolling of what is already there, and we have as little

power to affect the pattern of things to come as a man who weaves a carpet on a loom which is already set, or indeed as a man who unrolls an already woven carpet for our inspection."

The Indian mind which has any intimate touch with Samkhya thought would remember at once that this is Satkāryavad and that what the great mathematician Laplace thought in the nineteenth century was indicated in detail by Sāmkhya thousands of years ago. The ideas of ancient philosophers who existed nearly three thousand years ago in India are today repeated by Laplace and Jeans. Sāmkhya also said the same, yet Sāmkhya is more logical and more complete than determinism of the modern scientists. Sāmkhya does not believe that the carpet has already been woven, and so does Marxism imply. Both Sāmkhya and Marxism hold that the carpet can never be completed, because weaving is a process and every moment every human being is weaving his own carpet as he chooses and as the objective situation directs him or is itself being directed and fashioned. Each individual weaves into his life some new portions, and weaving it in just the way that

he wishes. It is an eternal weaving, no finality can be predicted. Man's action moves on the lines that his own karma is tracing for him. But his will is free to fashion his karma. It is determinism to the extent that karma which is dynamic is shadowed by mechanical and unchangeable law of karma; but life which is guided by free-will does not follow any pre-ordained pattern. Determinism thus appears as the guiding principle—as a law. But it is a law which operates through changes according to the conditions of each circumstance and environment; it is not a pre-ordained order. Hindu philosophy denies the existence of a hard and cruel fate, which would play with human life just as it pleases and crush it under its pressure; rather, Hindu philosophy has always declared—Man has complete control over his actions but his actions have no control over their results. The results are always irresistible.

Today the Scientists have experimented and done series of investigations and to a large extent, they have succeeded in their efforts in presenting a truer vision of the Universe. The unique progress

done on the study of things in their relations (as distinct from things in isolation) and in their changing role as distinct from absolute role (which are the essence of both Samkhya and Marxism) naturally suggests that human thinking would have brought much greater development if the progressive doctrines enumerated by Samkhya three thousand years ago had been worked upon by later philosophers and scientists. The materialist thinkers and scientists could have developed the applied side to material purposes as is being done now.

J. B. S. Haldane, in his "The Marxist Philosophy and the Sciences" writes in connection with Laplace's statement "Laplace who claimed that he had banished God from his system of nature, brought him back in this ghostly form to establish determinism." Haldane has been a bit too impatient about Laplace, who only expressed an unshakeable faith in determinism. He had found in nature, a law that like causes produce like effects. In a hyperbolical language, he had said that an ideally gifted mathematician, if he had before him all the data and used the laws of nature upon the data, could write down the future.

His statement only proves how strongly Laplace believed in Nature's uniformity. Elsewhere in the same book Haldane has said: "This does not of course mean that a very high degree of accuracy is not possible in the prediction both of physical and social happenings". If once this is admitted, determinism is accepted in the main. If so much can be predicted, does it not then imply that there is an underlying law? Assumption of such a law is the acceptance of determinism. The deeper and the more complex principles of nature had not been shown till then by laboratory methods. Samkhya also had banished God from its philosophy and in its place, accepted Nature—its eternal variability and everchangingness. It accepts the cause and effect relationship of Satkāryavad, that is, the principle that like causes produce like effects which is the same thing as the uniformity of Nature. For a thorough understanding of these principles we had better leave Laplace and take up contemporary scientists like Planck and Einstein in this analysis. The famous scientist Planck writes: "I have said that the first step which

every specialized branch of science takes consists of a jump into the region of metaphysics. In taking this jump the scientist has confidence in the supporting quality of the ground whereon he lands, though no system of abstract reasoning could have previously assured him of that. In other words, the fundamental principles and indispensable postulates of every genuinely productive science are not based on pure logic but rather on the metaphysical hypothesis —which no rules of logic can refute--that there exists an outer world which is entirely independent of ourselves. It is only through the immediate dictate of our consciousness that we know that this world exists. And that consciousness may to a certain degree be called a special sense."

Planck says elsewhere "The knowable realities of nature cannot be exhaustively discovered by any branch of science. This means that science is never in a position completely and exhaustively to explain the problems it has to face. We see in all modern scientific advances that the solution of one problem only unveils the mystery of another. Each hill top that we reach discloses to us

another hill-top beyond .... the aim of science is something more. It is an incessant struggle towards a goal which can never be reached. Because the goal is of its very nature unattainable. It is some thing that is essentially metaphysical and as such is always again and again beyond each achievement." In the same metaphysical strain Einstein is stated to have said "Honestly I cannot understand what people mean when they talk about the freedom of the human-will ..... I feel that I will to light my pipe and I do it, but how can I connect this up with the idea of freedom? What is behind the act of willing to light the pipe? Another act of willing?" Schopenhauer once said "Man can do what he wills but he cannot will what he wills."

One has every right to join issue with these scientists and he may even ultimately reject this attitude as more romantic than rational but the intellectual world must follow for sometime the logic which leads to the leaning towards metaphysics--the logic of the scientists whose works and researches have registered a high level of scientific progress; if the scientists have accepted an unseen

metaphysical conception, be it noted that it is in some cases by sheer force of mathematics* in the quest for reconciling inconsistencies of experimental physics. Surely, in this metaphysical leaning they have not necessarily ceased to be physicists.

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*The symbolical forms of expression of mathematics are here not merely indispensable tools for describing quantitative relationships, but they furnish at the same time an essential means for the elucidation of the general qualitative points of view. The hope expressed at the conclusion of the article that mathematical analysis would again prove capable of assisting the physicist to surmount his difficulties has in the meantime been fulfilled beyond all expectations..... .....It will interest mathematical circles that the mathematical instruments created by the higher algebra play an essential part in the rational formulation of the new quantum mechanics.....To the physicists it will at first seem deplorable that in atomic problems we have apparently met with such a limitation of our usual means of visualization. This regret will however, have to give way to thankfulness that mathematics in this field, too, presents us with the tools to prepare the way for further progress." (Bohr's *Atomic theory and the description of nature*)

"To draw quantitative conclusions we must use the language of Mathematics...Mathematics as a tool of reasoning is necessary if we wish to draw conclusions which may be compared with experiment." (*The Evolution of Physics* by Einstein and Infeld.)

CHAPTER IV

DIALECTICS

TILL now, the scientists had been working following Newtonian mechanics and of his successors* on the principle that *like causes produce like effects* which means uniformity of nature. But Planck's discovery of Quantum theory has shown the breakdown of uniformity of nature. The Quantum Theory refers to radiation of heat or for the matter of that, any radiant energy like heat, light, electricity, X-rays, etc. This theory seems to demolish the old theory that the radiant energy spreads like waves. The Quantum theory now shows that radiant energy spreads like a discharge of bullets. This theory,

*(1) Newtonian (1642-1727) or classical Mechanics involving absolute space and time and concerned with:

(a) Matter i.e. particles e.g. atoms, molecules etc.

(b) Radiation, i.e. waves.

(2) In 1887, Michelson-Morley experiment showed that the motion of the earth

apart from demolishing an older theory, gives a serious shaking to the conception of nature's uniformity and of causality.

Inspite of this so-called breakdown of causality or in the lack of nature's uniformity, we observe something uniform—something constant again—which is constant h. It is really so interesting that while uniformity of nature is seriously challenged by Quantum theory, it is, as it were, replaced by another feature of uniformity of nature (constant h) in the mathematical form. This constant h means that the radiant energy when measured will always be in integral multiples of $h\nu$ (where ν is the frequency and h is the universal constant). By the careful experimentations and technical skill Planck found the value of this constant to be 6.55×10^{-27} erg-seconds or to put it in more easy form stripped

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has no influence upon the velocity of light. (In classical mechanics, velocity of any motion has different values for two observers moving relatively to each other.)

(3) In 1897, J.J. Thomson, the versatile scientist formulated the theory that electrons carry negative electric charge. (all electrons are exactly alike being about 2000 times smaller than the lightest atom—

of mathematical fright, h means .0000000000 0000000000000000655 erg-seconds (the erg means the unit of energy and the second is the unit of time). Thus h becomes the quantity of energy multiplied by time. Energy divided by time is easily understandable by us in our three dimensional conception but when multiplied by time it becomes a difficult idea but all the same satisfies the four dimensional conception.

Still the matter is not so alarming for we can understand this universal h to mean that no radiation can be emitted unless it is of at least that amount or its integral multiple. To put it in the form of a common experience, our electric heater will give us heat only when it has accumulated that amount, again the intensity of heat will not increase until it ac-

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hydrogen atom.) Sometime later, it was further discovered that in the electron there is an electric charge only and it has a mass.

(4) In 1900, Quantum mechanics. Planck discovered his famous Quantum theory and showed that matter radiated in discrete quantity known as quanta, and not in a continuous series. Jeans, Rayleigh and Wien had also been working on this from different stand-points.

cumulates another Quanta which is exactly double that amount and so on. We can have 2 $h\nu$, 3 $h\nu$, 4 $h\nu$, 5 $h\nu$ and so on but no fractional part of $h\nu$ is possible.

True, Quantum theory has given a rude shock to the uniformity of nature. J. B. S. Haldane also points out the dissimilarity in effects:

"Why does this unstable molecule breakdown in an average time of half a second and this one in ten years? Why is this molecule stable in watery solution but unstable when united with an enzyme? The answers can be given, where at all, in terms of quantum mechanics, with its strange union of chance and necessity."

Indeed, strange is the union! but to a dialectical materialist there is not much strangeness about it. To a non-dialectician who thinks in terms of fixed categories, a

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(5) In 1903, Rutherford the great experimentalist scientist, propounded the theory that radioactivity is the breaking up of an atom into charged particles and radiation and the breaking up by themselves spontaneously without any special cause.

(6) In 1905, Einstein's Relativity Theory (Special) formulated that the velocity of light has the same value independent of

thing, a circumstance, a process is either accidental or necessary but not both—to him both exist in nature side by side and a thing must either be one or the other. If then it is contended that *necessity* alone prevails in nature, one is reminded of Engels' brilliant sarcasm:

"That a particular pea-pod contains five peas and not four or six, that a particular dog's tail is five inches long and not a whit longer or shorter, that this year a particular clover flower was fertilised by a bee and another not and indeed by precisely one particular bee and at a particular time, that a particular wind-blown dandelion seed has sprouted and another not, that last night I was bitten by a flea at four o'clock in the morning and not at three or five o'clock and on the right shoulder and not on the left calf—these are all facts which have been produced by an irrevocable concatenation of cause and effect, by an unshakable necessity of such a nature indeed that the gaseous

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the system from which it is measured or of the motion of the source from which it is emitted and showed the conception of space and time as *relative* as against the Newtonian view that they are *absolute*. To put it in easy language, when a train moves with a motion, the motion is real and true; so also the motion of the earth carrying the train real and true; so also the sun dragging the earth may have

sphere, from which the solar system was derived, was already so constituted that these events had to happen thus and not otherwise."

If, on the other hand, it is maintained that *chance* alone explains why a particular pea-pod contains six peas, not five or four, can it be equally maintained that the same chance will also explain the law of motion of the solar system? Further, if chance prevails then, in the words of Jeans:

"The whole of science would seem to be left hanging in the air, with no justification for its existence and no explanation of its success. Yet the success is indisputable and explanation there must be."

The explanation offered by a dialectical materialist lies not in the exclusive categories of chance and necessity but in the combination of the two. It is always a union of chance and necessity. Chance in

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moved nearer one planet and further away from another. These are all relative to some other moving body. Eddington says:

"And so the position of Einstein's theory is that the question of a unique right frame of space does not arise. There is a frame of space *relative* to the terrestrial observers, another frame *relative* to the nebular observers, others *relative* to other stars. Frames of space are relative. Distances, lengths, volumes—all quantities of space-reckoning which belong to the

nature baffles a complete comprehension and appears meaningless and whimsical as it is not possible to understand, say, when why and where the wind blows a seed and where the seed finds a congenial soil for germination and such other natural phenomena. The fact however is that as nature's law is being more and more discovered, it gradually offers explanation for what looked on the surface as blind. If necessity can be equated with causal relationship, some phenomena or events can be explained by physical and environmental conditions, etc., but others are again matters of chance. To this extent, necessity leads to determinism. What Engels suggests is that the explanation lies in the inner necessity in living nature and not in the mechanical determinism. He

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frames—are likewise relative.....Absolute distance, not relative to some special frame, is meaningless."

Einstein and Infeld may be quoted for further elucidation :

(a) Special theory applies only to inertial systems i.e. those systems for which the laws of mechanics are valid (i.e. to systems in which the law of inertia, as formulated by Newton, is valid). "The special theory of relativity is based on two fundamental assumptions : physical laws are the same in all coordinate

confirms, elaborates and explains Hegel's idea :

" That the accidental has a cause because it is accidental and just as much also has no cause because it is accidental; that the accidental is necessary, that necessity determines itself as chance and on the other hand, this chance is rather absolute necessity."

This is a very subtle philosophical thought and obviously the most refined thinking in terms of dialectics is necessary in order to understand the working of nature. From one aspect, chance or accident implies the existence of a law and a sudden departure from the law, the reason of which is not traceable owing perhaps to imperfections of physical apparatus and human knowledge experimental or theoretical. It is for science to investigate more and more with full comprehension of dialectics and

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systems moving uniformly relative to each other; the velocity of light always has the same value.....the old laws are invalid if the velocity of the moving particle approaches that of light."....." If we have two coordinate systems moving non-uniformly, relative to each other, then the laws of mechanics cannot be valid in both."

(b) " The question as to whether an inertial system exists at all is still unsettled. But if there is one such system, then there is an

find out under what special conditions or circumstances, any break in the continuity or a departure from the law may have taken place. The lack of uniformity in the physical phenomena was further emphasised by Einstein when in 1905 he gave the structure of radiation, i.e., constitution of light which Max Born describes:

"Planck's Quantum energy is an extremely small amount. Yet this very minute discontinuity of the process assumed by Planck had dramatic consequences. Five years later Einstein came forward and declared that Planck had said far too little. According to him, discontinuity does not merely occur in the emission and absorption of light; no, light itself by no means consists of smooth waves but is quite discontinuous or quantized; in short, it behaves like a rain of particles, photons or light quanta."

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infinite number of them. Every C.S. moving uniformly relative to the initial one is also an inertial C.S." (coordinate system is what we may call frame of reference).

(c) "The laws of mechanics are not rigorously valid on the earth due to its rotation. A C.S. rigidly connected with the sun can be regarded for many problems as an inertial C.S."

(d) The question is "Can we formulate physical laws so that they are valid for all C.S. not only those moving uniformly but also those moving quite arbitrarily, relative to each

The formulation of the constitution of light was another step in the direction of Planck's discovery and a confirmation of lack of determinism. With this, the Relativity principle opened out new implications. The Relativity began to explain many phenomena but the effects cannot be observed for events of ordinary life due to largeness of velocity of light. In illustrating the difference in the experiences of our ordinary motion and a rapid motion under a hypothetical velocity, Eddington has observed as follows :

"Although we cannot try the experiment of sending a man to another part of the universe, we have enough scientific knowledge to compute the rates of atomic and other physical processes in a body at rest and a body travelling rapidly, We can say definitely that the bodily processes in the traveller occur more slowly than the corresponding processes in the man

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other ?" " Could we build a real relativistic physics valid in all C.S. a physics in which there would be no place for absolute, but only for relative motion ? The problem of formulating physical laws for every C.S. was solved by the so-called General Relativity theory." Thus the theory of Relativity is built up in two stages.

In the last few years, studies of space and time in relation to velocity of light have

at rest (i.e. more slowly according to the Astronomer Royal's time). This is not particularly mysterious ; it is well known both from theory and experiment that the mass or inertia of matter increases when the velocity increases. The retardation is a natural consequence of the greater inertia. Thus so far as bodily processes are concerned the fast moving traveller lives more slowly. His cycle of digestion and fatigue ; the rate of muscular response to stimulus ; the development of his body from youth to age ; the material processes in his brain which must more or less keep step with the passage of thoughts and emotions ; the watch which ticks in his waist coat pocket ; all these must be slowed down in the same ratio ; If the speed of travel is very great we may find that, whilst the stay-at-home individual has aged 70 years, the traveller has aged 1 year. He has only found appetite for 365 breakfasts, lunches etc. ; his intellect, clogged by a slow-moving brain, has only traversed the amount of thought appropriate to one

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changed radically our outlook and the present conceptions may be summarised as below:

(i) The appearances of things will remain unchanged as long as we can observe space and time separately. A distinction between space and time is possible when the velocity of things observed is much less than the velocity of light.

(ii) It follows therefore that when the velocity of things observed is comparable, i.e.,

year of terrestrial life. His watch, which gives a more accurate and scientific reckoning, confirms this. Judging by the time which consciousness attempts to measure after its own rough fashion—and, I repeat this is the only reckoning of time which we have a right to expect to be distinct from space—the two men have not lived the same time between the two meetings."

The next serious shock from which the law of causality was almost breaking down was when Rutherford showed that atoms at times disintegrate themselves spontaneously and at times behave in a different way and secondly, when Bohr discovered that the electron of the atom does not travel uniformly in a continuous stream but by jumps. These great discoveries of Rutherford and Bohr brought crisis after crisis upon the idea of determinism, because they amply demonstrated that nature had hardly any such law of uniformity. But it was not long that

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of the order of the velocity of light, then the appearance of things in the world will be quite different and the nature of the phenomenal world cannot be explained by any popular language (for words can only describe things of which we can form mental pictures ..... fortunately mathematics is not subject to this limitation) or

following Heisenberg's famous New Quantum Mechanics, it was shown that although there occur sudden breaks and jumps in the motion, still they are so minute at times that the effect for all practical purposes is continuous and uniform. Jeans writes :

"When a problem is solved by the classical mechanics, the solution we obtain depicts continuous motion and change ; when it is solved by the quantum mechanics, the solution tells us of jumpy motions and changes of the kind we have already met in Bohr's theory of the hydrogen atom—if the solutions of the classical mechanics describe a ball rolling down an inclined plane, those of the quantum theory describe it as bumping down a staircase. The amount of each jump is proportional to h, so that in problems in which pq is a large multiple of h, each jump is so small compared with the main motion that the succession of jumps becomes indistinguishable from continuous motion. In this way, the jumps of the quantum theory merge into the continuous motion of the Newtonian mechanics."

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even by Newtonian mechanics but can be explained by Einsteinian mechanics

i.e., by Four dimensional Geometry or continuum;

i.e., by Time Space unity Conception;

i.e., by mathematical treatment as per four dimensional Geometry.

On the one hand, there is the unpredictable death of the atom and the uncontrolled jumps of the electron, on the other hand, Planck would claim and so would Einstein that "it is not the principle of causation itself which has broken down in modern physics but rather the traditional formulation of it ..... "

The severe shock to the theory of uniformity of nature was from the peculiar behaviour of matter and radiation. Heisenberg writes :

"From these experiments it is seen that both matter and radiation possess a remarkable duality of character, as they sometimes exhibit the properties of waves, at other times those of particles. Now it is obvious that a thing cannot be a form of wave motion and composed of particles at the same time—the two concepts are too different. It is true that it might be

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For a pictorial illustration, let me assume a hypothetical case where the velocity of light is taken to be the same as the ordinary speed of a cycle (say 10 miles per hour) in which case Mr. T. will see the road-side policeman as usual but will see an approaching cyclist flattened (moving body contracting but mass increasing, though mass not outwardly visible) in the direction of the motion. When later Mr. T. began to bike

postulated that two separate entities, one having all the properties of a particle, and the other all the properties of wave motion, were combined in some way to form "light." But such theories are unable to bring about the intimate relation between the two entities which seems required by the experimental evidence. As a matter of fact, it is experimentally certain only that light sometimes behaves as if it possessed some of the attributes of a particle but there is no experiment which proves that it possesses all the properties of a particle; similar statements hold for matter and wave motion."

In this connection, Eddington gives a caution and makes a very useful observation:

"There is nothing new under the Sun and this latest volte face almost brings us back to Newton's theory of light.....a curious mixture of corpuscular and wave theory. There is perhaps a pleasing sentiment in this "return to Newton"; But to suppose

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himself faster to catch the cyclist, he found the "streets grew shorter, the windows of the shops began to look like narrow slits and the policeman in the corner became the thinnest man he had ever seen." When finally Mr. T. overtook the cyclist, he was surprised to find the cyclist a normal man while both of them were in the same motion.

This dependence of appearances of things upon the relative velocity of observer (in

that Newton's scientific reputation is specially vindicated by De Broglie's theory of light is as absurd as to suppose that it is shattered by Einstein's theory of gravitation."

It is thus seen that determinism got shock after shock to such an extent that the world of science began to be convinced of its breakdown. One has to remember that this breakdown is in the realm of the infinitesimal, i.e., in the behaviour of electrons, etc.. It is mainly the quantum theory which has shown lack of causality and the theory refers to the phenomena on minute scale just as, in a general way one can say, that relativity theory refers to phenomena on grand scale. Dirac in his "Principles of Quantum Mechanics" says:

"Causality applies only to a system which is left undisturbed. If a system is small, we cannot observe it without producing a serious disturbance

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relation to velocity of light) causes inconsistencies which can only be removed by the assumption of four dimensional space time unity. In Newtonian mechanics, everything is absolute—that an observation is absolute and independent of the observer or the observed. Einstein discovered just the contrary and for the first time, brought into Physics, the concept of Relativity as the

and hence we cannot expect to find any causal connection between the results of our observations. There is thus an essential indeterminacy in the Quantum theory, of a kind that has no analogue in the classical theory, where causality reigns supreme. The quantum theory does not enable us in general to calculate the result of an observation but only the probability of our obtaining a particular result when we make the observation."

While breakdown of determinism in some respects is clearly observable, one cannot ignore the fact that some kind of determinism reappears in the form of statistical laws because even indeterminate events are governed by such laws. Just as statistical laws can give a general theory of the likely changes in the population of a country upon the country's birth-rate and death-rate, so laws can be found which can govern the behaviour of crowds

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ultimate explanation, i.e., the relative motion of the observer and the observed.

Four dimensional continuum has been explained by Einstein and Infeld in *The Evolution of Physics:*

"Indeed, not two, but four, numbers must be used to describe events in nature. Our physical space as conceived through objects and their motion has three dimensions and positions are characterised by

of electrons. It is apparent however that determinism exists in the case of man and society —the past and present can indicate the future generally though not precisely. As a matter of fact, man is concerned mainly with himself *i.e.*, things on grand scale where determinism reigns supreme which is evident from the fact that laws for his social, political and cultural development so far have not broken down. When, therefore, a scientist raises a note of alarm about the breakdown of causality, he really refers to the atomic world, which may be his immediate subject of investigation. It must be admitted however that even in matters on grand scale, scientists have not yet been able to say that determinism and causality can be traced for every thing in every sphere, for, there are some fundamental things beyond man's understanding for the present at least.

three numbers. The instant of an event is the fourth number. Four definite numbers correspond to every event; a definite event corresponds to any four numbers. Therefore, the world of events forms a four dimensional continuum..... The world of events can be described dynamically by a picture changing in time and thrown on to the back-ground of the three-dimensional space. But it can also be described by a static picture thrown on to the back-ground of a four dimensional time-space continuum."

When Einstein superseded Newton's law of gravitation by a more general theory he has not been able to trace from beginning to end why one star revolves in one way and another in another way, beyond the very important discovery that they so behave because that is their natural motion. Newton believed in "straight line path" as the motion of all unhampered bodies according to Euclidean Geometry and when planets were found not moving in straight lines he concluded a force of gravitation pulling it away from the straight path, but Einstein's greatness lies in the fact that he accepted the natural motion to be what it is. He worked on the plan that the continuum must have different metrical properties in different parts and these are the

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Gamow writes:

"Whereas in classical physics time was considered as something quite independent of space and motion flowing equably without relation to anything external, in the new physics space and time are closely connected and represent just two different cross sections of one homogeneous space time continuum in which all observable events take place."

(7) Rutherford's atom ..... had been investigated theoretically by Nagaoka in 1904. Here electrons circulated as 'planets' round

causes of different distributions of matter in different regions and these different distributions of matter caused different movements. Thus a planet moves, in Einstein's theory, round the sun in an ellipse because the neighbourhood of the sun has such a matter as would make ellipse the natural motion of the planets. It is in this connection that Einstein predicted for the light-ray a curved path near the sun and now subsequent observations are confirming this prediction.

Such were the materials before Einstein and such was his treatment of the materials. To accept an observation as a physical fact and then try for investigations with the help of corroborative materials and physical apparatus detaching himself completely from the

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a small positive 'sun.' It was Rutherford who in 1911 convincingly strengthened the evidence for this model. But in this theory, the serious defect was that the atom vanishes by continually losing energy.

(8) In 1913, the great scientist Niels Bohr made a great discovery that in respect of atomic structure, i.e., electron in the atom, it moves in definite orbits. While rotating, it does not radiate energy but radiates in quanta while jumping from outer to the

investigating tools so that personal bias may not deflect the correct line of investigation is the attitude of a scientist; on the other hand, to give a metaphysical interpretation to an observation and try for a supposed reality beyond the observation, to explain everything by rigid conceptions and search for phenomena and explanations in support of preconceived notions, to create a body of arguments in support of the fixed ideas whether for scientific, social or political matters is the attitude of an idealist.

There is yet a third attitude which belongs to the dialectical materialist. This attitude combines a scientist's attitude with a consciousness that theory and practice are bound together, inter-dependent and mutual-

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inner orbits. The Russian scientist Gamow says:

"Bohr was the first to express the idea that the internal motions of any mechanical system may possess only a discrete set of possible energy values and the motion can change its state only by finite steps, a definite amount of energy being radiated in each of such transitions."

(9) In 1917, Bohr's 'Kangaroo jump' and Rutherford's disintegration of the atom of a radio-active substance were connected by Einstein's law of spontaneous emission.

correctives. The supreme test of this attitude is the open mind recognising the co-existence of opposite tendencies and fusion into new forms. So long as this elasticity of mind will remain, a conscious self-intrusion will form another important part of the investigation. Indeed the old idea of detachment and investigation by 'pure mind' is an impossibility. The fact is that the investigator does come in and when he must come in, he should come in very consciously for it is in this way that a wrong bias can be shed. In *Philosophy and History*, a volume presented to the renowned methodologist Cassirer, Mr. Edgar Wind writes:

"But what the statement now conveys is not only simple, but also true: the investigator intrudes into the process that he is investigating. This is what

(10) The problem of disintegration was clearly explained by Gamow with the help of Quantum theory in 1928.

(11) From the special theory (1905) of Relativity, Einstein came to his General theory of Relativity in 1917 which is a law of gravitation from which can be deduced his law of motion—which is primarily a law of curvature. Einstein's theory is purely geometrical in form and states that the space is not only four dimensional but is also

the supreme rule of methodology demands. In order to study Physics, one must be physically affected; pure mind does not study physics. A body is needed —however much the mind may 'interpret'—which transmits the signals that are to be interpreted. Otherwise, there would be no contact with the surrounding world that is to be investigated. Nor does pure mind study history. For that purpose, one must be historically affected; caught by the mass of past reference that intrudes into the present in the shape of tradition, demanding, compelling, often only narrating, reporting, pointing to other past experience which has not as yet been unfolded.....By his intrusion into the process that is to be studied, the student himself, like every one of his tools, becomes a part-object of investigation.....If the physicist were nothing but a physical apparatus, there would be no physics; nor would history exist if the historian were merely an

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curved. Curvature has been explained by Gamow :

"We mathematicians call surface curved if the properties of geometrical figures drawn on it are different from those on a plane and we measure the curvature by the deviation from the classical rules of Euclid i.e., on a plane the sum of the angles of a triangle is equal to two right angles."

Experiments indicate that the space is curved. In discussing why a planet takes spiral track, Eddington writes :

"The Newtonian scheme says that the planet tends to move in a straight line but the sun's gravity pulls

historical document....the physicist disturbs the atoms whose composition he wants to study....True he does not disturb the star but the nexus of nature in which the star is only a member."

Heisenberg in his Principle of Uncertainty has already proved and confirmed that the investigator does affect the investigation and that there is no getting away from this fact.

What is true in the investigation of atomic world may not be necessarily true in social matters. Yet it is true that the investigator influences the investigation. Self-intrusion does not mean one's bias and predisposition but it means the scientific and cultural tradition of the investigator. Pure mind and pure thought have to be understood accordingly. It is abundantly patent that many important

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it away. Einstein says that the planet tends to take the shortest route and does take it."

Bertrand Russell writes in connection with this law of gravitation :

" Einstein says that the sun is at the top of a hill, only the hill is in space-time, not in space (I advise the reader not to try to picture this, because it is impossible)." And Planck in his " The universe in the light of modern physics " writes " The theory of Relativity is the crowning point of physics, since by merging the ideas of time and space, it has also succeeded in uniting under a higher point of view

and significant thoughts, ideas and observational matters are embodied in the theories and philosophies of the ancient masters who soared high in 'pure thought' and their achievements are marvellous. The achievements of Kapila, Kanāda and Bādarāyana in India and Democritus in Greece are of a very high level of "thought". In their process of thinking, they had an extraordinary dynamic power of assimilating ideas. Today all that is left is a veneration for the past and in that veneration what is completely lost is the dynamic power of absorption. In the realm of pure thought, a comparative picture of a scientist and a philosopher may be quite interesting.

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such concepts as those of mass, energy, gravitation and inertia."

(12) Quantum theory led to the formulation of two branches of Statistics relating to the behaviour of photons and particles :

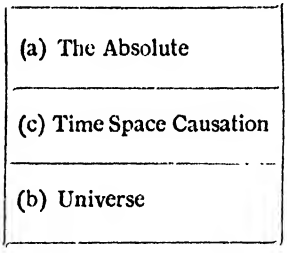
(i) Bose-Einstein Mechanics (1924)

This was originally devised by S. N. Bose. Einstein developed this idea. This applies to photons (light quanta) and neutral atoms. This system reckons particles as indistinguishable, contrary

Heisenberg in his "*Physical Principles of Quantum Theory*" gives the following pictorial representation :—

Either Phenomena described in terms of space and time but Uncertainty principle	Alternatives related statistically	Or Causal relationship expressed by mathematical laws but Physical description of phenomena in space time impossible.

It is rather intriguing to find in a lecture delivered in 1896 in London by Swami Vivekananda the following along with the pictorial form set below :—



"This absolute (a) has become universe (b) by coming through time, space and causation (c). This is the Central idea of Advaita. Time, space and causation are like the glass through which the absolute is seen and when it is seen on the lower side it appears as the universe.

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to classical theory that they are distinguishable. This statistics has such an important bearing that Dirac has recently given a special name 'bosons' to these particles. In 1935, a Japanese scientist Yukawa gave a theoretical prediction of Mesotron (meson) obeying Bose-Einstein statistics which has become a unique work of fundamental importance upon its actual subsequent discovery in

Indeed, here is a striking resemblance between a pure thought (before Quantum theory and Relativity theory) and laboratory investigations (after Quantum theory and Relativity theory). The observation of Heisenberg is particularly significant:

"Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of past centuries. At that time these abstractions could be disregarded as mere mental exercises by those scientists whose only concern was with reality but to-day we are compelled by the refinements of experimental art to consider them seriously."

The situation is thus extremely complicated even for the best of scientists but if a lay-man has a right to understand the world in which he lives, he has to bring out in an

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cosmic radiation. It has been further developed by Bhaba among others. Particles of integral spin must satisfy this statistics.

(ii) Fermi-Dirac Mechanics (1926). This statistics applies to fundamental particles of half-integral spin.

(13) Heisenberg's New Quantum Theory 1925. Bohr's conception of the atomic structure was found unsatisfactory in many

easily understandable form the trend of scientific thoughts out of the large body of physical experiments, observations and theoretical discussions. To put the present position in the most popular language even at the cost of scientific precision, it may be summed up that in (a) the man-sized phenomena of the phenomenal world, determinism obtains as we see in our ordinary observations and happenings, in (b) the atomic and sub-atomic world of the phenomenal world, however, indeterminism or break-down of causality occurs as often as determinism is obtainable; and in (c) the world outside (which has been called 'real' world by some scientists as distinct from phenomenal world) which is a metaphysical world or in

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complex cases (hydrogen was a simple case) and Heisenberg on the basis of all empirical observations of the radiation (spectra) emitted by the atoms devised a purely mathematical theory.

Here I may place Bohr's Theory of atom side by side with Heisenberg's. In Bohr's theory, electrons revolve round the central nucleus in different orbits and occasionally jump out from one orbit to another emitting radiation. But in this theory, stability of

other words, a conceptual world, the application of abstract mathematics specially adapted to eliminate all inconsistencies of the phenomenal world, has established determinism. If all inconsistencies can be really resolved by abstract mathematics, abstract mathematics become a key to a new world and the conceptual world becomes no less a real world or a perceptual world than the phenomenal world.

This may be the conclusion at this stage of evolution of science. The serious thinkers of dialectics assert that the scientific laws have come no nearer finality than the social and historical laws. During the past half a century, Mathematics and Physics have made unique progress (inspite of their al-

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orbits could not be reconciled with the fundamental laws of emission of radiation from an accelerated electron. Heisenberg's mathematical theory of the electron has no physical model but he conceived electron as embodiment of the directly observable quantities.

(14) Upon this New Quantum Theory, Matrix mechanics was developed by :

(i) Max Born and Jordan,

(ii) Dirac.

leged metaphysical bent) astounding particularly to those who got stuck at that time. By the new techniques they are now circumventing the problems which they thought would not be solved except by miraculous ways. Mathematics and Physics have not yet adopted mysterious or miraculous methods. In the course of their mathematical investigations, they have struck upon an assumption which they at times call 'real' world and at times 'metaphysical' world by which they mean mathematical reality (four dimensional continuum) behind these appearances. Sullivan in his *Science* puts

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Max Born says :

In 1925 Heisenberg put forward a decisive idea ; this was seized on by Jordan and myself, who worked out the appropriate mathematics, the so-called *matrix mechanics*.....This form of quantum mechanics, which was also brought to a high degree of perfection by Dirac quite independently, is not only the earliest form of quantum mechanics but perhaps also the most fundamental.

Dirac, however, developed matrix mechanics into his symbolic method which is a more general method.

(15) Wave Mechanics of De Broglie and Schrodinger (1926).

this so-called metaphysical concept more clearly :

" Space and time cannot be the completely separate entities we thought they were. They must be connected in some way, and the distinction we make between them must be, to some extent, illusory. This fact was brought out very clearly by Minkowski, some three years after, Einstein's first paper appeared. He showed that the reality lying behind appearance is a continuum having four dimensions. Each observer splits this continuum up into three dimensions of space and one dimension of time. The way in which he effects this partition depends on his motion. All observers with the same motion live in the same space and time.

The old Wave theory (Diffraction and Interference) could not explain many problems. Experiments have shown that the electron behaves at times like a particle and at times like a wave and also showed that light behaves at times like a particle and at times like a wave and have thus created, a very difficult, inconsistent and anomalous situation baffling to the scientific world.

In 1924, De Broglie, on the lines of the dual behaviour of radiation, built up a similar theory for the electron called wave theory of electron. Subsequently Schrodinger raised it to Wave mechanics as distinct from particle mechanics (Newtonian).

An observer having a different motion lives in a different space and time. These different spaces and times are cross-sections, as it were, of the one four-dimensional reality."

If from all these, scientists and thinkers conclude that this world in which we live is illusory and that the mathematical space-time unity conception reveals a *more* real world, then it must be asserted that the basis of Einstein's theory has not been understood even by those who are supposed to understand it and that the theory has been made a pretext for scientists to wallow in an emotional and romantic attitude towards the the Universe. If it is true that the scientists' new conception is on the ground that ex-

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Jeans says :

" We saw how radiation which was once thought to be wholly undulatory, can be pictured as possessing some of the properties of particles – a beam of radiation falling on a material surface may be pictured as a shower of photons, each located at a definite point of space and possessing mass and energy. We now find that a shower of electrons, which was once thought to consist wholly of particles, may be pictured as possessing some of the properties of waves.....these waves form the subject matter of the wave mechanics and at the same time, as we have seen, provides a pictorial representation of Heisenberg's Quantum mechanics."

periments and observations backed by mathematics, physics and hard logic have brought this irresistible conclusion and that it is a physical experience and an observation which can be repeated as many times as the intelligent observer wants to observe, then it is not a metaphysical world as is usually understood by the term—it is a perceptual world, though not as perceptual as the world of gross bodies and the world of electrons but all the same it is an extra-phenomenal world i.e., a continuation of this phenomenal world in another cross section of the reality where the essential structure and appearances of the gross bodies can be comprehended viewed in space-time unity

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Schrodinger's Wave mechanics and the Matrix mechanics of Born—Heisenberg.

Born and Dirac came to the same result. Though mathematically the same, philosophically there is a difference which Eddington puts as follows:

"It is here that the three theories differ most essentially. Obviously q and p cannot represent simple numerical measures, for then qp—pq would be zero. For Schrodinger p is an *operator*. His momentum is not a quantity but a signal to us to perform a certain mathematical operation on any quantities which may follow. For Born and Jordan p is a *martix*

in four dimensional concept. In this new conception, the only objection is that an assumption has been made the basis viz, what is observable in the case of electron in the laboratory holds good elsewhere too or to put it philosophically, the clear assumption is that the fundamental laws of nature are the same all over the Universe. In the existing position of physics, the present assumption of four dimensional geometry is holding the field and is getting gradual corroboration but the law of dialectics can never accept that mathematics and physics have nothing more to reveal of the Universe in their future progress. It may as well be that the present assumption, on getting a rude shock

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not one quantity, nor several quantities, but an infinite number of quantities arranged in systematic array. For Dirac p is a *symbol* without any kind of numerical interpretation ; he calls it a q number which is a way of saying that it is not a number at all."

(16) Heisenberg's principle of uncertainty 1927.

Accepting the dual nature of wave and particle, so far the mathematical explanations have been given. To go deeper into the causes why the dual nature is visible, Heisenberg showed that this dual nature is

from future experiments and observations, will yield place to a further rational and material assumption of observable nature. Yet we have an eminent scientist like Bohr saying:

"We must only be prepared for the necessity of an ever extending abstraction from our customary demands for a directly visualizable description of nature."

Another eminent scientist Dirac also writes in his *Principles of Quantum mechanics*:

"The classical tradition has been to consider the world to be an association of observable objects (particles, fluids, fields etc.) moving about according to definite laws of force, so that one could form a mental picture in space and time of the whole scheme.

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due to our treatment in space and time separately in which we observe things. So the theory demonstrates that not only the appearances of things depend upon the relative motion of the observer and the observed according to Einstein, but their relationship is further deepened by an interaction—the smaller the interaction, the greater the mass determined by the quantum of action of the observed thing in relation to the Planck constant. To put the theory in the language of Science:

"The 'Uncertainty Principle' is the assertion that we can never know (for instance) both the position and momentum of an electron exactly.

This led to a Physics whose aim was to make assumptions about the mechanisms and forces connecting these observable objects, to account for their behaviour in the simplest possible way. It has become increasingly evident in recent times, however, that nature works on a different plan. Her fundamental laws do not govern the world as it appears in our mental picture in any very direct way, but instead they control a substratum of which we cannot form a mental picture without introducing irrelevancies. The formulation of these laws requires the use of the mathematics of transformations."

The materialists believe in the unceasing and ever-new manifestations of nature and it is by logical assumptions that nature is brought out in all manifestations. Some materialists may resent at assumptions but

Humanly speaking, of course, we can never know anything empirical exactly at all ; but Heisenberg's was a further and precise assertion that the very physical means we take to get within p of the momentum ensure that we shall not get within q of that position ....." (Science since 1500 by Pledge)

" If p and q be the position and motion respectively of an electron, the pq and qp will not be entirely identical." The difference between pq and qp is found to be always the same being Planck's constant h multiplied by a numerical multiplier." (Jeans).

[c] (17) Dirac's Relativistic Theory of Electron (1928).

it is not given to them to do so if they are real believers in unceasing unfolding of nature. It is by assumptions and their continued struggle that nature's complex working is brought to human comprehension. Sometime ago, ether was assumed as the medium for light waves and was generally accepted by the world of science but in the absence of mathematical confirmation, the best scientific mind was not fully satisfied until Maxwell proved that light waves were electro-magnetic waves and light was an electro-magnetic phenomenon. Here again confirmation was lacking but this time not from mathematical side but from experimental side, as Maxwell developed his theory mathematically. It was

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Though Schrodinger's representation is more popular yet all the representations failed to satisfy the principles of Relativity. Dirac however formulated a mathematical scheme. Indeed; " the most fundamental theoretical advance in the field in recent years has been the discovery of the Relativistic wave equation of Dirac ". Dirac for the first time successfully combined Quantum theory with Relativity. Dirac's theory therefore corrects the defects of the previous theories (Schrodinger's) and lays down, as the pioneer work, the theory of

then Hertz who after 20 years in 1886 confirmed Maxwell by a series of wonderful experiments. Inspite of electro-magnetic theory, the notion of ether was not given up. This led Michelson to experiments and he concluded that ether was dragged along by the earth in its own movement. But this idea came in conflict with other phenomena and so another solution was called for. At last, Fitzgerald and Lorenz gave a theory that everybody in motion undergoes contraction and thus reconciled the existing phenomena with stationary ether. With Relativity theory, ether as a substance finally disappeared being a superfluous hypothesis.

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fundamental particles satisfying quantum and Relativity theories. It was Dirac who on this line of work predicted mathematically a positive charge and this prediction was subsequently confirmed by the discovery of positron.

(18) The Relativistic theory of electron of Dirac suffers from some defects. He already formulated a theory remedying this defect but within the frame work of the same classical theory. Corresponding to this achievement of Dirac upon electron, Bhaba following the same lines formulated the classical theory of meson.

Such is the chequered history of science. These broad events during the period between Euclid and Einstein and the landmarks in the development of Quantum theory and Relativity theory (as presented in the running footnote pages 65—106) will illustrate the dialectical mode in science. For the inner working of dialectics in the actual phenomena in the different branches of science J. B. S. Haldane's *Marxist Philosophy and the sciences* will throw much light. It is now for experts to continue the work in details and unfold the dialectical working of natural phenomena in all spheres and phases. These landmarks indicate the scientist's procedure: The scientists start in their laboratories with

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Dirac's recent work has been to put his theory in the frame work of Relativity and Quantum theories—but it is not yet complete.

The dual character of wave and particle is visible only when its quantum of action (i.e., m × a × v) is larger than the Planck constant. If the quantum of action becomes comparable (p. 104), i.e., of the same order with the Planck Constant (6.55×10^{-27} ergs per sec.) then the ordinary dual nature (which is both particle and wave) will appear and in order to understand this phenomena,

phenomena as they see, watch their behaviour under different conditions, attempt confirmation by mathematical formula—if not confirmed by physical experiments or by mathematical treatment—then reject them and search for solution—in their search, they constantly check their work by empirical observations as a reliable guide—hence the trial and error method is largely the method of dialectics if the principles of transformation, unity and negation are kept in view. What is most surprising and also disheartening is that the same scientist coming out of laboratory, suddenly begins to think and also act not dialectically with the objective situation as he was doing in his laboratory

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Heisenberg's new quantum mechanics will have to be applied. Here is the limitation of Newtonian mechanics. Therefore we get two limits for Newtonian mechanics, i.e., our ordinary physical conception (i) Planck Constant (ii) Velocity of light (C being velocity of light which is 186000 miles per second).

*Take Hydrogen
electron :— m (mass of the electron) $= 10^{-27}$ gram.
" a (radius of the atom) $= 10^{-8}$ cm.
v (velocity) $= 10^{9}$ cm. per second.
Therefore mav $= 10^{-27} \times 10^{-8} \times 10^{9} = 10^{-27}$ which is comparable with Planck constant

but emotionally in the pursuit of ideals and concepts in respect of social, political, and economic matters—he begins to think that social and economic ideas of the dim past are eternal verities and not liable to change in the context of human development. Coming out of the laboratory he begins to forget how in science, developments took place one upon the other—*how* Euclidean Geometry worked upon by Newton gave the basis of modern physics and when it could not explain

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Thus we find that the quantum of action of the electron in a hydrogen atom being of the order of Planck constant can no more be regarded as a particle in classical mechanics but is to be regarded as gradually merging into a wave or cloud and taking the appearance of an electron cloud. Thus the motion of electron round the nucleus is not analogous to the motion of planets round the sun as we used to think before.

Bohr in his *Atomic theory and the description of nature* writes :

" Just as the Relativity theory has taught us that the convenience of distinguishing sharply between space and time rests solely on the smallness of the velocities ordinarily met with compared to the velocity of light, we learn from the quantum theory that the appropriateness of our usual causal space time description depends entirely upon the small value of the

all phenomena, *how* Einstein rejected the Euclidean Geometry and working upon Minkowski's four dimensional conception and Riemann's Geometry worked out revolutionary changes in science, i.e., in man's conception and in explanation of the universe and its phe-

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quantum of action as compared to the actions involved in ordinary sense perceptions."

Summing these up, physics may be said to be now at a critical juncture. The theory of Relativity has given a new conception of space and time by which appearances of things are relative to the conditions *in* which things are seen and also *by* which things are seen ; the Quantum theory has given us a new conception of matter and radiation by which appearances of things are dependent upon the quantum of action in relation to Planck constant ; these two theories have so much revolutionised our ideas of appearances of things which we have so long considered as the only and absolute appearances that the observable universe becomes true only in one cross-section—indeed a very large cross-section. Any attempt at a complete comprehension of the universe will not only require many more discoveries but also in the process it will make the investigator more humble than even what a Marxist can imagine.

nomena; *how* Quantum* mechanics shaking the very foundation of determinism has thrown open new thinking processes amongst the scientists ; these scientists have engaged themselves in the investigation of problems like ether waves†, or the true structure of atom or the laws of motion which have not only to explain gravitation but also have to lay down the general laws for all solar systems and others ; *how* trial and error method has been applied to objective conditions of phenomenal universe without any preconceived notion in favour of any particular theory or without any special sanctity to any particular design. The living minds partially discarded

*Quantum physics formulates laws governing crowds and not individuals. Not properties but probabilities are described, not laws disclosing the future of systems are formulated but laws governing the changes in time of the probabilities and relating to great congregations of individuals. (Einstein).

†Ether waves are called by different names according to their wave-length. The longest are the Hertzian waves used in broadcasting; then come the infra-red heat waves; next come waves of ordinary visible light; then ultra-violet photographic or chemical rays ; then X-rays ; then Gamma rays emitted by radio-active substances. Probably the shortest of all are the rays constituting the very penetrating radiation found in our atmosphere....(Eddington).

Newton because they know that science is not omniscience—what was not available to Newton may be available to us. Thus the living minds allowed theories to be modified, ideas to be discarded and all these changes conform to the law of dialectics. On the other hand, in this hemisphere nothing can be modified—*where* Lilavati's mathematics, Nagarjun's chemistry and Vedic sciences are still considered as a high intellectual pursuit relegating the modern mathematics, chemistry and science problems to comparative seclusion; —*where* economic implements invented in the dawn of civilization are still regarded as mighty machines breathing eternal heavenly music; *where* philosophical theories, discussions, speculations of a simple, easy-going and leisurely society reaching a marvellous height of intellectualism of that period, are considered final and eternal—no matter that man and his environment have completely changed today in the break-neck speed of events.

True, the human society is a much bigger and more complex laboratory than the laboratory of the scientist. But the scientist who is looking into the solar system through the laboratory aperture is also engaged in

the great task of examining minute* things and also massive things, he adopts the same methodology of the dialectics as should be applied to the society. It is always worth remembering that scientific laws are also discovered—not *made* from nature, that the discovery is slow and gradual. To think that the laws of science have been finally discovered is to say that the universe has come to its end. To say that the laws of dialectics have been finally formulated is equally offensive and anti-Marxist. The three laws of dialectics mentioned earlier have to be thoroughly tested by thinkers and scientists in their application to scientific and social phenomena. As Marxism is not a closed system—not a dogma, it allows and it insists that its laws formulated so far must be subjected to a revision or restatement in the light of procession of discoveries of nature. If the laws cannot explain all changes in the

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* "A drop of water contains several thousand million million million atoms. Each atom is about 100 millionth of an inch in diameter. Within the atom are the much smaller electrons pursuing orbits, like planets round the sun.....About 10^{21} atoms build a man's body. The mass of the sun is 2000000000000000000000000000000 tons." (Eddington).

process of social and scientific evolution, they require modification. The application of dialectical method to social, economic and political matters will be far more revolutionary, effective and spectacular than the application of it in the realm of science—because some kind of dialectics is inherent in the very nature of scientific investigation. The sphere of science does not interest the common man—the common man breathes in the atmosphere of social, political and economic matters and unless the growth of man and his society is correctly comprehended he does not know his role and unless he can play a conscious role in the great tasks he is not a dialectician—only a floating straw in the current. The laws of dialectics give an insight into the working of nature—it is not a supernatural agency which lies outside of nature and exterior to her working.

This attitude is that of a Marxist materialist. The most efficient tool in his hands is Dialectical Materialism. Of the many features, one important point is that it does not look upon things in fixed categories and thus when thinkers and scientists were racking their heads in establishing either chance

or necessity, either particle or wave, the Dialectical materialist did not find anything perplexing, for, to him chance and necessity may be the two aspects of the same thing i.e., what looks like chance may be the result of necessity hiding behind it. In the same way, the particle and wave may be the dual nature of the same thing i.e., the character of the particle does not necessarily exclude the character of the wave. It is the Idealists and romantic scientists who feel that they must explain each thing either by the one or by the other. Even if the eminent scientists fully engage themselves with the question of particle or wave, this is still not considered an anomaly by the Dialectical Materialists, for, they readily accept the dual nature of things. That is why the famous Russian scientist Vavilov writes :

"The conceptions of an elementary particle or of a wave which previously seemed mutually exclusive became fused in the dialectical synthesis of the real object.....In the case of light, the same dialectical duality was revealed still earlier than in the case of matter. In all its actions on matter, a light wave was found to be equivalent to a stream of elementary particles photons or light quanta—and the century-old conflict of the wave and the corpuscular theories

of light came to an end, at least at a preliminary stage, by the real synthesis of these opposites. The temporary and relative character of all boundaries and frontiers in nature was also demonstrated with exceptional clearness by the remarkable fact of the possibility of converting light into matter in the process of forming a pair of positive and negative electrons from a gamma-photon."

It is this synthesis of opposites which reminds us of Engels' idea expressed as early as 1878 :

"Truth and error like all concepts which are expressed in polar opposites, have absolute validity only in an extremely limited field.....As soon as we apply the antithesis between truth and error outside of that narrow field.....it becomes relative and therefore unserviceable for exact scientific modes of expression ; and if we attempt to apply it as absolutely valid outside that field, we then really find ourselves beaten ; both poles of the antithesis become transformed into their opposites, truth becomes error and error truth."

Then Engels points out :

"Really scientific works therefore as a rule avoid such dogmatic and moral expressions as error and truth, while these expressions meet us everywhere in works such as the philosophy of reality, in which empty phrasemongering attempts to impose on us the sovereign result of sovereign thought."

In the same way space and time, which used to be regarded by the Newtonians as completely separate and exclusive categories, have now been proved by Einstein as inseparable property of matter. Vavilov therefore says :

" In Einstein's theory, space time is an inseparable property of matter itself, it depends on matter, it alters with matter and without matter it has no existence. We donot know any space without matter, without material fields of force. Such is the basic idea of Einstein's general theory of relativity which found also concrete physical forms. In this theory the idealist conception of space time as a category of thought is swept away, and the Newtonian scheme of metaphysical objective space without physical properties is relegated to the archives of history. Before us arises the first outline, still far from perfect, of the dialectical materialist understanding of space-time. Once again dialectical materialism has triumphed."

Inspite of this epoch making discovery after three hundred years, by a supreme genius, scientists who are studying it suddenly relapse into exclusive categories which makes one feel that the philosophical implications of such discoveries are not probably realised even by some scientists. Inspite of Nature's

pointer to the law of dialectics which expresses itself in the form of union or synthesis as the relatively ultimate condition of things, if we still tax our brains for exclusive categories and eternal truths and thus compartmentalise nature, then we shall never know nature as a living force but come to inconsistent conclusions upon the most pompous theses on dead sectional experimentations. It is in this connection that Engels wrote the following:

"The analysis of nature into its individual parts, the grouping of the different natural processes and natural objects in definite classes, the study of the internal anatomy of organic bodies in their manifold forms—these were the fundamental conditions of the gigantic strides in our knowledge of Nature which have been made during the last four hundred years. But this method of investigation has also left us as a legacy the habit of observing natural objects and natural processes in their isolation, detached from the whole vast interconnection of things; and therefore not in their motion, but in their repose; not as essentially changing, but as fixed constants; not in their life, but in their death. And when, as was the case with Bacon and Locke, this way of looking at things was transferred from natural science to philosophy, it produced the specific narrow-mindedness of the last centuries, the metaphysical mode of thought."

Upon these observations of the scientists, what has the dialectical materialist got to say? He has one simple thing to say but behind this simple thing, a world of implications exists there. The simple thing is: elastic attitude towards the changing world, an attempt at unity of theory and practice, a conscious role in the light of history and tradition are the fundamentals to make one a dialectical materialist—otherwise he is a mechanical scientist, a closed thinker and a fossilised philosopher.

To the dialectician, electron's behaviour need not be something fixed—wave and particle can easily be the two aspects—they do exist together but each appears separately and independently—such a situation is not only possible but fully explainable with the concept of dialectics. According to the dialectician, it is wave while passing through one medium and it is particle while passing through another medium.* Thus the same thing passing through different media gives different results. It is, therefore, both—

*"Experiments demonstrate quite clearly that light and matter unite in themselves properties of waves

sometimes the one, sometimes the other. In the society this is the true significance of what people mean by truth and error. In social phenomena too, it is the medium, i.e., the people who determine the quality of the government whether it is good or bad and not the government itself; it is the people again through which the society changes its complexion from feudalism to capitalism and capitalism to socialism. Those who think in terms of fixed conceptions and categories and invoke the gods for social and scientific development are dead to the extraordinary workmanship of living nature.

While the dual nature may exist, yet it does not preclude the possibility of a higher synthesis. The scientists should strive for it—study of nature may open a new vision. I

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and properties of particles. We therefore cannot say that they are one or the other: they are both, displaying one side of their nature or the other, according to the type of obstruction they meet." (Max Born's *The Restless Universe*).

"The electron behaves like a particle when moving in an external electric or magnetic field. It behaves like a wave when diffracted by a crystal. With the elementary quanta of matter we came across the same difficulty that we met with in the light quanta." (Einstein's *Evolution of Physics*).

cannot do better than quote the language of the great scientist De Broglie who in *Matter and Light* writes :

" The history of the different theories of light has given us a splendid example of the success of such a series of synthesis in one particular branch of Physics. We must not be surprised, however, if on many occasions the discovery of a new series of phenomena destroys our finest theories like a house of cards ; for the richness of Nature is always greater than our imagination. It requires, indeed, some boldness in physicists to attempt the reconstruction by thought of part of the plan of the Universe : the miracle is that they have sometimes succeeded."

The synthesis of two opposites may be best put in the language of Marx :

" The existence of two mutually contradictory aspects, their conflict and their flowing together into a new category comprises the essence of the dialectical movement."

The synthesis or the unity of two opposites is achieved through the conflicts of contradictions upon which the dialectical materialism lays particular and essential stress. An analysis of reality into component parts will lay bare the opposite tendencies. Lenin says :

"We are unable to imagine, express, measure or depict motion without interrupting that which is continuous, without simplifying, approximating, separating and petrifying that which is alive. The depiction of the movement of thought is always an approximation, an act of petrification—and not merely of thought but also of sensation and not merely of motion but of all conceptions. Therein lies the essence of dialectics. And it is this essence that is expressed in the formula—the unity, the identity of opposites."

Opposites arbitrarily chosen and contradictions without their natural background will give no unity—it is only the opposites as they exist in reality that have the potentiality of a synthesis on a higher level.

In social phenomena, the grand subject illustrating the unity of opposites lies in the productive activities of the society : the Bourgeoisie and the Proletariat though opposites have combined into a social formation under the economic title capitalism. The unity, however, does not mean golden mean or an equilibrium. Freedom and slavery constitute an antagonism. Marx says :

"Slavery has its two sides. Let us leave alone the bad side and talk about the good side of slavery ..... Direct slavery is just as much the pivot

of bourgeois industry as machinery, credits, etc. Without slavery, you have no cotton, without cotton you have no modern industry. It is slavery that has given the colonies their value, it is the colonies that have created world trade, and it is world trade that is the pre-condition of large-scale industry.....Wipe out North America from the map of the world and you will have anarchy—the complete decay of modern commerce and civilization. Cause slavery to disappear and you will have wiped America off the map of nations."

Upon this, a bourgeois social thinker would, at the best, like to get rid of the bad side and preserve the good side. But he should know that it is an impossibility without a radical social change. The society with conditions in which slavery can exist must necessarily face the inevitable consequences of those conditions. The supreme fact has to be recognised that the feudal form or the bourgeois form of production and society, idealist thoughts or any other kind of thoughts are historical and appropriate for the time and serves a very useful and progressive role for that time. The good and the bad sides of any social state cannot be harmonised and balanced into a golden mean culled from the bosom of the unknown. Such an attempt

at balancing is not the implication of synthesis—the implication is that social relations have to be so brought about, by altering the basis on which the present day economic relations rest, that a higher form of synthesis is possible of achievement. Marx says :

" This thesis, this thought, opposed to itself, splits up into two contradictory thoughts—the positive and the negative, the yes and the no. The struggle between these two antagonistic elements comprised in the antithesis constitutes the dialectical movement. The yes becoming no, the no becoming yes, the yes becoming both yes and no, the no becoming both no and yes, the contraries balance, neutralise, paralyse each other. The fusion of these two contradictory thoughts constitutes a new thought, which is the synthesis of them. This thought splits up once again into two contradictory thoughts, which in turn fuse into a new synthesis."

In natural phenomena, there are contradictions, opposites and mutually exclusive tendencies and yet they associate and form a unity. It is unity in the sense that there is transition to a new form through conflict of opposites. The materialist dialectician whose elastic attitude comprises in looking at a phenomenon as a whole—in its inter-relations and in its totality will have to

seek, by all analytical means including trial and error method, for the contradictions and yet those only which have dialectical potentialities. Here is the need for acute scientists and social thinkers to discern those significant factors in preference over the casual or isolated factors eclectically chosen at random. The entire effort of the scientist or the social thinker backed by the accumulated traditions of the past stages has to be applied on one point, *viz.*, the discernment of the proper factors at any particular stage as being the driving forces of progress and development from state to state, from form to form. Herein lies the process of dialectics.

Dialectics do not operate only through unity of opposites, but also through transformation of quantity into quality or negation of negation etc. A typical example of transformation is the change at the boiling or freezing point of water. Society and science both offer examples. In the case of negation of negation, the classic example of Marx is taken from the field of economics. He showed that the workers ceased to own the means of production but in course of this process of negation, a time would come when it would

again be negated and monopoly would become a fetter upon the mode of production. Society and science furnish many examples which will show that progress and development proceed in this way.

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